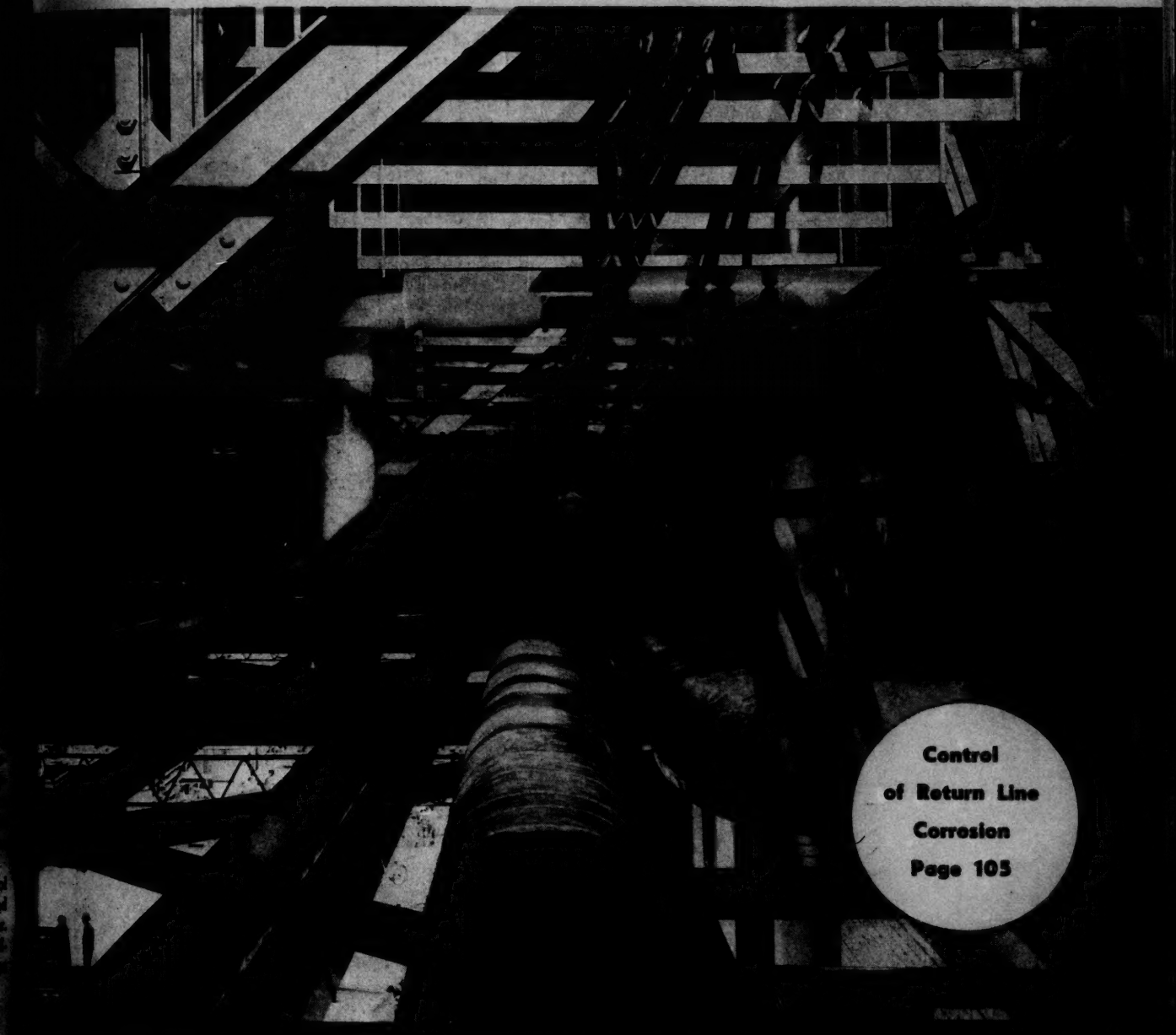
NOVEMBER, 1952

HEATING AND VENTILATING

INCLUDING AIR CONDITIONING – PIPING – REFRIGERATION – AIR SANITATION



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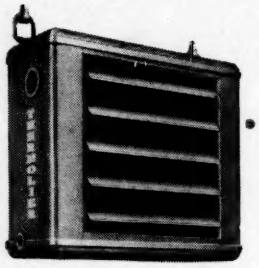
FOR CLASSY SHOPS
. . . OR BUSY PLANTS

The condensed table below is a quick guide to the selection of the correct Thermolier for specific conditions. The capacities, when motors are operating at normal speeds, are based on Standard Basis of Rating: 2 lb. steam pressure and 60° F entering air temperature. Grinnell Thermoliers are tested and they are rated in strict accordance with rules of the Industrial Unit Heaters Association.

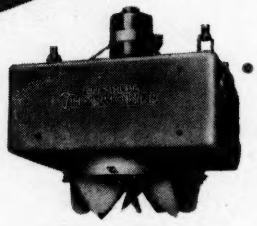
All Thermoliers can be operated at working steam pressures up to 125 psi and steam temp. up to 406° F.

A MODEL AND SIZE FOR EVERY PURPOSE



horizontal delivery

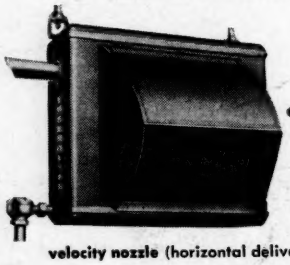
textile (horizontal delivery)



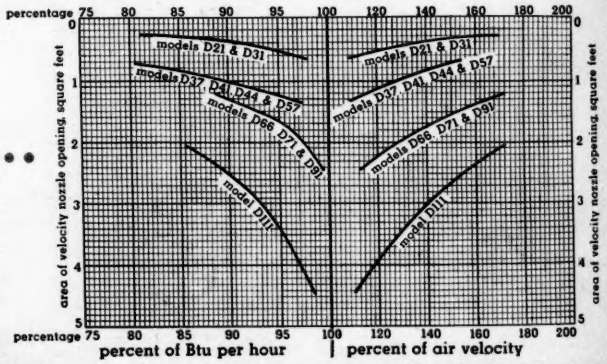
vertical delivery

model	total heat delivered, Btu per hr	sq ft edr (nominal)	air velocity at exit, louvers open, lin. ft. per min.
horizontal delivery			
D21	35,600	148	786
D31	48,700	203	851
D37	62,200	259	753
D41	71,000	295	901
D44	84,100	350	887
D57	101,300	422	1016
D66	128,700	536	779
D71	151,700	632	977
D91	196,000	817	985
D111	275,300	1147	1048
Textile			
TX70	69,800	291	826
TX110	113,700	474	877
vertical delivery			
VA1042	50,800	212	1399
VA1045	73,600	307	1287
VA1065	109,400	456	1354
VA1075	145,600	607	1231
VA1101	185,000	770	1495
VA1111	257,000	1071	1631

performance with velocity nozzle ▶



velocity nozzle (horizontal delivery)


percentage
75 80 85 90 95 100 120 140 160 180 200
0 1 2 3 4 5
area of velocity nozzle opening square feet
models D21 & D31
models D37, D41, D44 & D57
models D66, D71 & D91
model D111
percent of Btu per hour
percent of air velocity

GRINNELL
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Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

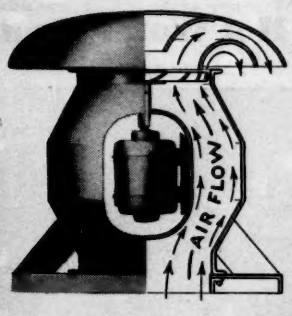
Manufacturer of: pipe fittings • welding fittings • forged steel flanges • steel nipples • engineered pipe hangers and supports
Thermolier unit heaters • Grinnell-Saunders diaphragm valves • prefabricated piping • Grinnell automatic fire protection systems

Exit Fumes
FROM NEW INTERCHEMICAL PLANT

12 BIFURCATOR FANS

33 ROOF VENTILATORS

HOW THE BIFURCATOR FAN WORKS

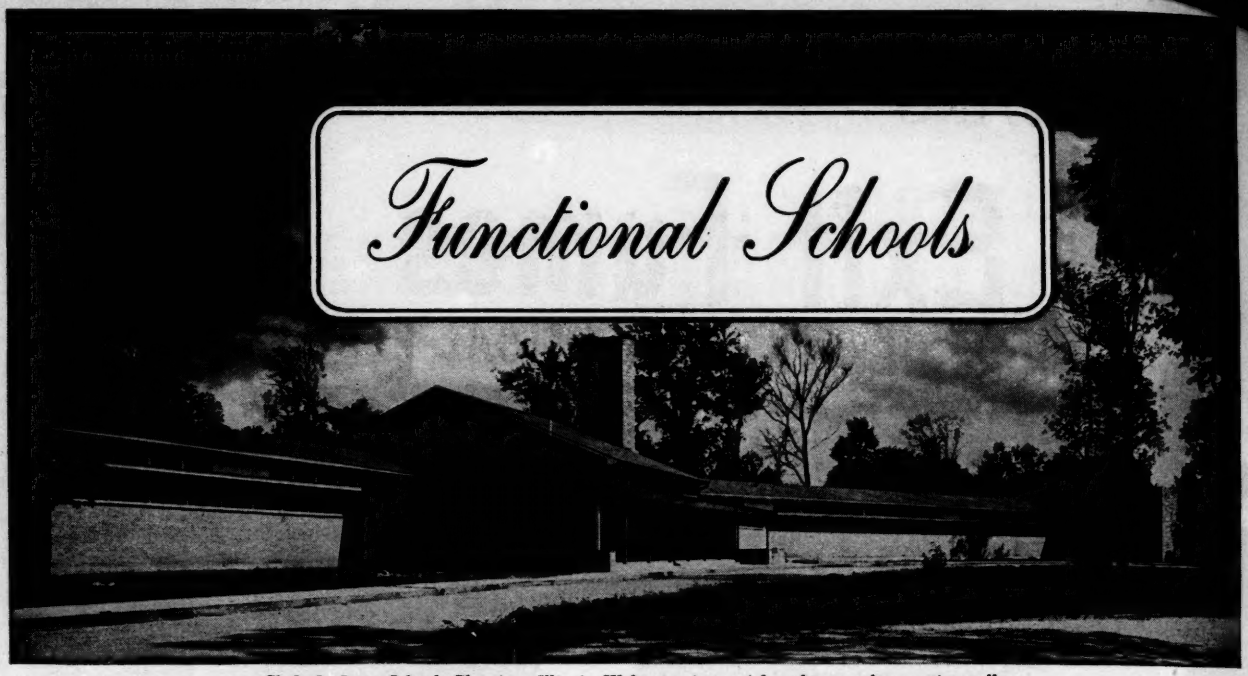


The DeBothezat Bifurcator is a direct motor-driven fan with a divided housing. Corrosive fumes are by-passed around the motor, which is mounted in a separate chamber, open to atmosphere but isolated from exhaust fumes. Bifurcator Roof Ventilators are equipped with weather-proof head and mounting base.

FREE CATALOG
available on both DeBothezat Bifurcator Fans and Power-Flow Roof Ventilators. Ask your local DeBothezat agent or write the factory, Dept. HV-1152.

DeBothezat Fans

Division of American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS



Clyde L. Lyon School, Glenview, Illinois. Walvector in special enclosures along entire walls of windows assures comfort regardless of outside temperatures. Photo by Hedrich-Blessing.

Perkins and Will, nationally known Architects and Engineers, specify "perimeter" heating for comfort and economy . . . .

Many schools designed by this Chicago firm feature large glass areas, for beauty, better vision and more cheerful classrooms. To off-set resulting heating problems, the consulting engineers, E. R. Gritschke and Associates, have specified Webster Walvector Tru-Perimeter Heating for comfort and economy in many of the Perkins and Will schools.

Webster Walvector gently and evenly warms the exposed walls of the building. Heating-up is quick, and easily controlled. Buildings can be heated just before occupancy and the heat lowered as soon as they are empty. No blowers, fans or filters are required. Webster Walvector uses less piping than conventional radiator systems. There's no expense to conceal unsightly pipes in furred walls or trenches, no complicated run-outs.

Webster Walvector may be used in new construction or modernization with forced hot water or low pressure steam. See the Webster Representative for complete details, or write us.

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In Canada, Darling Brothers, Limited, Montreal

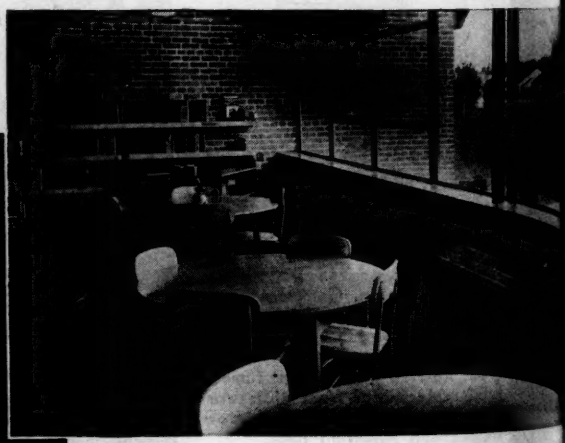
Webster WALVECTOR

REG. U. S. PAT. OFF.

For Steam or Hot Water Heating

Left below: Teacher's lounge in Technical Building, Evanston Township High School, Evanston, Illinois. The exposed walls are heated with Webster Walvector painted to match wall color. Photo by Hedrich-Blessing.

Right: Library in Cascades Elementary School, Jackson, Michigan. Auditorium and gymnasium, in separate wings, are available for community use without opening the school proper.



HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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Also Publishers of
HEATING & PLUMBING EQUIPMENT NEWS
and technical books.

THIS MONTH'S COVER

Piping distribution system at Douglas Aircraft Oklahoma plant is in overhead trusses. Austin Co. photo sights along boiler house wall. For tips on control of return line corrosion, see page 105.

Washington News

LORING F. OVERMAN

MANY things of interest to those concerned with heating, ventilating, plumbing and air conditioning can be read between the lines of the 7th Quarterly Report of the Director of Defense Mobilization, submitted to President Truman by Henry Fowler, Defense Mobilization Director. Filing of the report came just two years after enactment of the Defense Production Act. The report indicated that we have come a long way since the word was given to defend Korea, and that the facilities of business, industry and the military have just begun to feel the impact of the defense program.

In his report, Mobilization Director Fowler points out that "Since Korea our output of military hard goods—planes, tanks, ships and other equipment—has risen from $900 million per quarter to about $6 billion, or about three quarters of the rate at which we are aiming. Deliveries of all procurement items, plus construction, have risen from $1.2 billion a quarter to about $8 billion."

Is That Good?

For those who have no qualms about pouring billions into war materiel, the 7th Quarterly Report may be regarded as a satisfactory "progress report."

The document goes on to point out that "new funds made available by the Congress in July brought to $129 billion the amount available for expenditure on all military procurement and construction programs since Korea. About $41 billion worth has been delivered or constructed; some $58 billion more is in process or on order; and contracts covering most of the $30 billion remainder will be let during the next nine months."

"To complete the remaining $88 billion of military goods on schedule will be a huge task," says the report, "and to this amount will be added whatever funds the new Congress authorizes. From now on, the problem is one of identifying the specific gaps that remain in the mobilization base, and of closing them."

New "Opportunities"

Mr. Fowler's report next tosses into the other side of the scale a few words to balance the waste that goes with war.

"We should consider now," he said, "the new opportunities that will be ours, starting in 1953, when many of our resources will begin to move ahead of the requirements of the present security system. Expansion of our industrial capacity is going forward at a record rate. These additional resources can be utilized for further building toward peace, freedom, and stability throughout the world.

"Our capacity for producing steel, aluminum, electric power and petroleum has been expanded; and additional capacity in those industries will be ready in each succeeding quarter of 1953."

The report goes on to point out that the expansion goal for aluminum has been raised to 1.7 million tons—200,000 tons more than the previous goal, while the date of completion remains the same, January 1, 1955. Plans for adding as much as 400,000 tons to the 1955 goal are being made for 1958.

The expansion goal for electric power has been increased from 107 million kilowatts to 117 million a year, with the date extended from the end of 1954 into the year 1956. Need exists for greater capacity in non-defense activities as well, it was pointed out.

"People are looking forward," the report says, "to building schools, hospitals, stores, roads, irrigation and flood control systems, and improved consumer goods."

And says Mr. Fowler:

"These are the things that add to our standard of living and to the strength of the Nation. On them, in the long run, all of our security programs depend. Resources for these purposes have been curtailed for the last two years, in spite of the country's growth. As more and more materials reach a balance between supply and demand, including amounts for stockpiling, we will be able to relax and remove the controls on the distribution and consumption of materials for civilian use. The way will then be open for catching up on the improvements we have been deferring because of the more urgent needs of the military program."

Construction Order Relaxed

Recognizing housing and certain other types of construction as basic to a contented economy, relaxation of the construction order, effective May 1, 1953, was announced during the pre-election weeks. Direction 8 to Revised CMP Regulation 6 eliminated the distinction between "industrial construction" and the category "all other construction," and will permit both to self-certify like quantities of steel, copper, and aluminum. Orders for such self certified materials for new categories set up by Direction 8 may be placed at any time, provided they do not specify delivery before May 1, 1953. Under the new direction, "all other construction" includes industrial, commercial, public, hospital, university, school, public utility, water and sewage projects and transportation facilities.

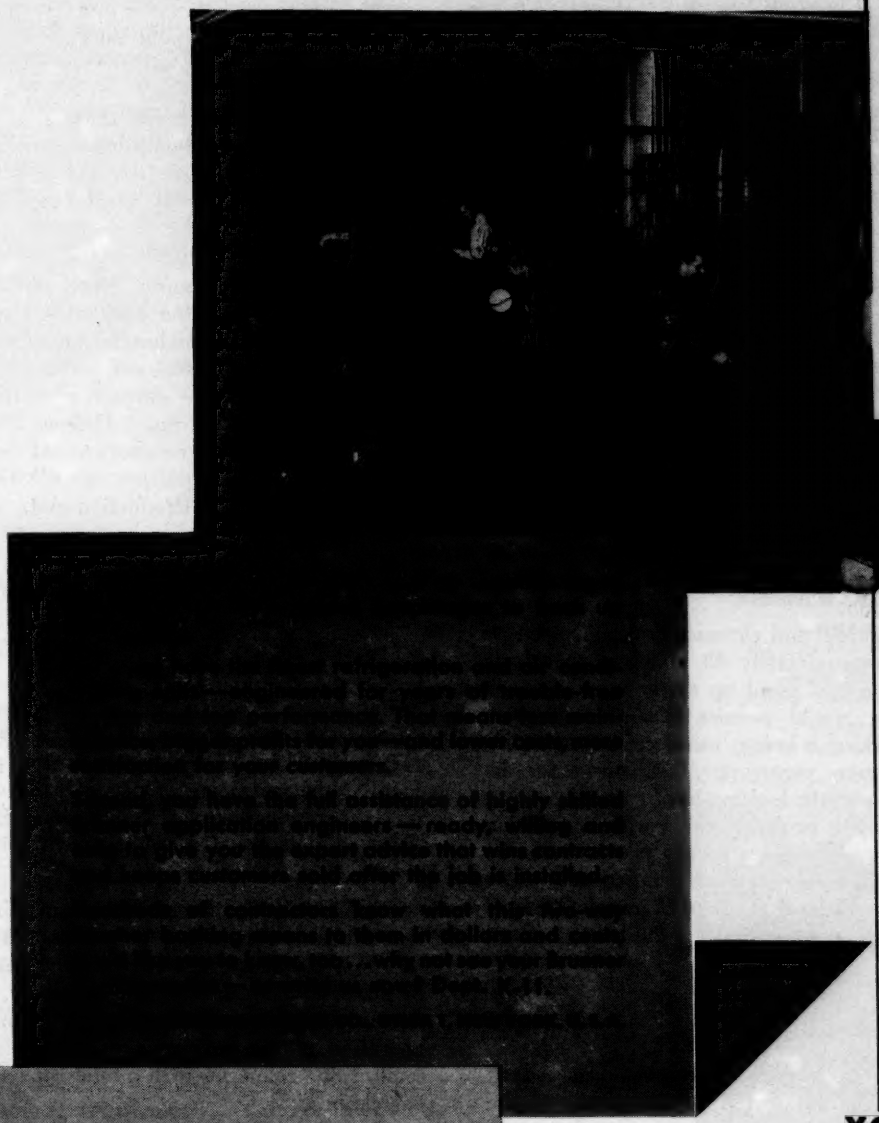
The Construction Industry Advisory Committee was scheduled to meet on October 29 to discuss proposals to advance the effective date of the order.

School Construction Lags

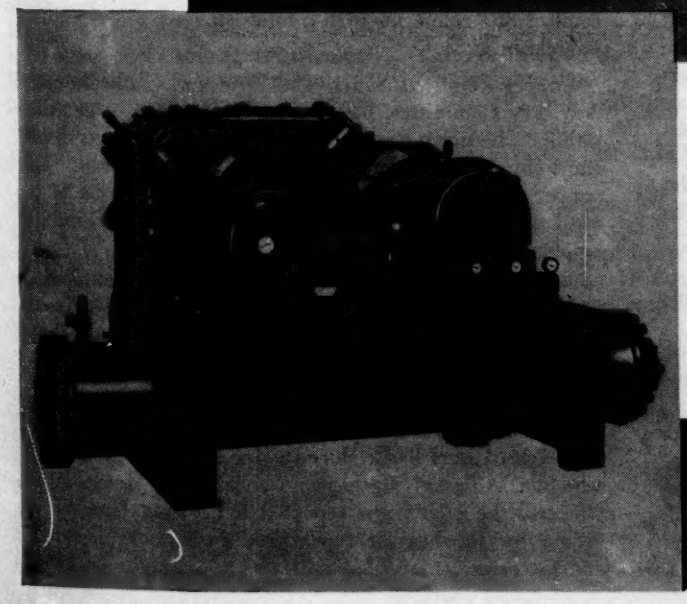
Some in Washington are eyeing the school construction picture as a possible stopgap which could be used in helping stabilize the economy when defense spending turns downward. Figures assembled by the Federal Security Agency, Office of Education, and the Department of Commerce, indicate that classroom space is getting shorter and shorter. During the year prior to the 1952 fall enrollment, approximately 47,500 classrooms were completed. But it would have taken 50,400 rooms just to house the 1,422,000 increase in enrollment. In addition, an estimated 11,200 rooms have been lost in recent years

BACKING YOU UP ON THE BIG JOBS . . .

[AND THE LITTLE ONES, TOO!]



In modern Brunner engineering laboratories, trained refrigeration engineers conduct the never-ending search for "ways to make it better"...



For every air conditioning or refrigeration need . . . Brunner condensing units from ¼ HP to 100 HP—69 air and water cooled models.

Self-contained Brunner Packaged air conditioning units up to 10 HP.

YOU CAN'T BEAT

BRUNNER

SINCE 1906

AIR CONDITIONING AND REFRIGERATION

through forced abandonment of overage structures. So, to keep pace with enrollment alone, the school plant needed 15,100 more rooms than were built.

Many of the 28,229,000 youngsters were housed in inadequate buildings, including barracks and rented structures. Adequate housing would have required 252,000 additional classrooms in 1950-51, according to official estimtaes. This figure despite five years of record classroom construction at a rate of over 49,000 per year! Enrollment increases are expected to exceed the million per year rate in 1953 and 1954, after which they will shrink rapidly. By the fall of 1958 the school plant will have to prepare for some 726,000 new youngsters per year (about half this year's increase), and minimum obsolescence should be about 12,000 fewer rooms than are now being built per year. It is at this point that we can begin catching up on the backlog.

Future Needs

It has been estimated that at current prices (about 75 percent above 1950-51) expenditures of $1.9 billion would have to be made this year to take care of next year's rise in enrollment and to replace buildings which can no longer be used. Spending is not expected to reach that figure this year. The record was set at $1,293 million in 1950-51, and the spending rate now is rapidly approaching $1.7 billion.

The backlog of public and elementary school needs is expected to total approximately $3 billion a year from now. To bring the school plant up to the standard considered satisfactory would require several times that amount. So this backlog is being considered as a possible —and certainly a more constructive—substitute for defense spending. It is worth looking into.

Detailed answers will probably come with completion of a nationwide school facilities survey provided for by the 81st Congress. The survey is well under way under the direction of the Federal Security Agency, Office of Education, and will be ready during the present fiscal year.

Defense Inventions Award

Establishment of an Incentives Contributions Award Board which would be authorized to recommend to the Defense Secretary the giving of monetary awards to persons making inventions useful to national defense may soon be considered by Congress. Staff of the House Judiciary Committee has proposed that the committee make such a recommendation. Under the proposed bill, the Defense Secretary would be authorized to award up to $75,000 without Congressional approval.

Five criteria for awards are proposed:

1. The novelty, originality and utility of the contribution.
2. The extent to which it was made at the expense of the contributor and extent to which it was made at Government expense.
3. The extent to which the contributor has benefited or can be expected to benefit through commercial exploitation.
4. The extent to which the contributor has been denied commercial exploitation for security reasons.
5. The extent to which he has been compensated by the Government for the contribution through salary, aid and the like.

Washington Miscellany

New Fuels Reviewed. Of interest to those who must engineer equipment to burn new fuels is a new Bibliography of Technical Reports, available at 50 cents per copy through the Office of Technical Services, Department of Commerce, Washington 25, D. C. Subjects reviewed in the current Bibliography include: synthetic liquid fuels, annual report of the Secretary of the Interior for 1951 on oil from coal and shale; fluidized drying and briquetting low-rank western coals; effect of surface active agents on petroleum fuels.

Valve-Fitting Expansion. Small business has been assigned 30 percent of the $50,000,000 of added capacity for the production of industrial valves and fittings. Firms with no more than 400 employees will be considered small business for the purpose of this expansion goal, and may apply to the Small Defense Plants Administration for certificates of necessity to aid them increase their capacity under the rapid tax amortization program provided in the defense Production Act.

Of the $50,000,000 expansion goal, certificates have been granted for $29,000,000 and applications received for $14,600,000 more. This leaves $6,400,000 of the expansion goal still open. Qualified small firms wishing to participate should apply to the nearest field office of the National Production Authority.

But there's a catch. The Small Defense Plants Administration emphasized that although it can arrange rapid tax writeoff for at least part of the cost of the new facility, the certificate of necessity does not carry with it any assurance that scarce materials will be made available, or that the Government will purchase the item produced.

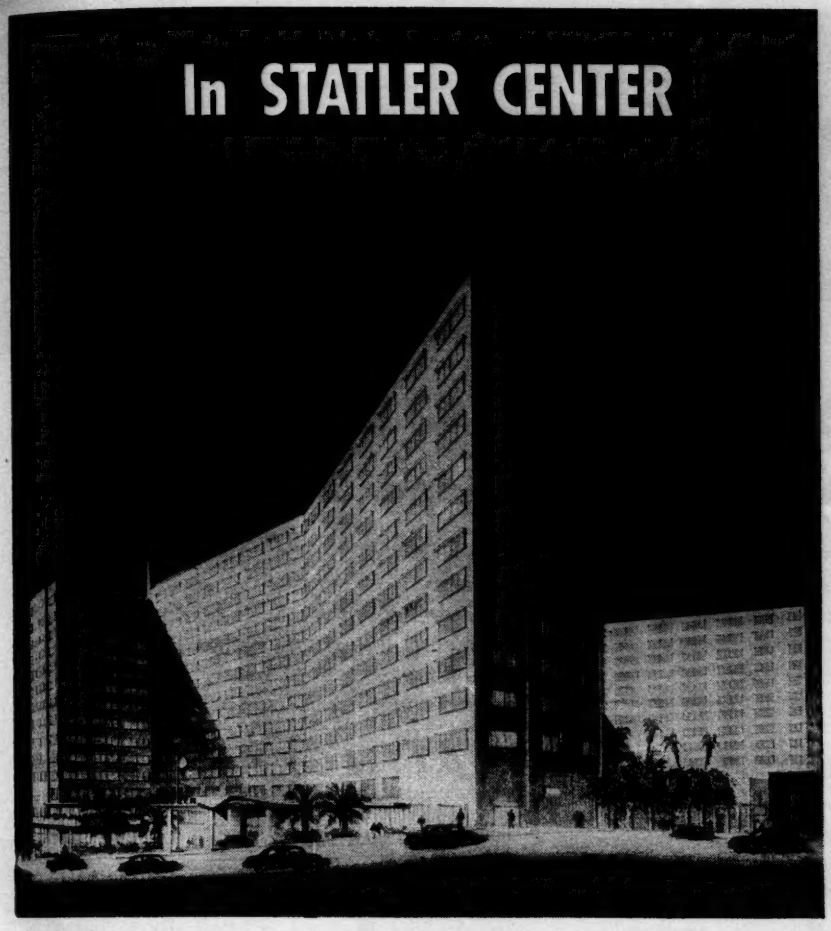
Oil Capacity Up. Recent Bureau of Mines report shows that the total number of petroleum refineries decreased in 1951, but that crude-oil charging capacity continued to increase. The survey, made annually, showed 350 refineries having a daily capacity of 7.3 million barrels, in operation at the beginning of 1952, compared with a total of 357 refineries with a total capacity of 6.9 million barrels in 1951.

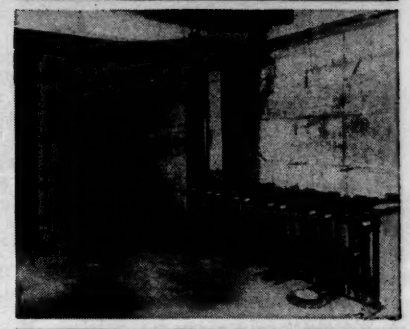
Copper Reported Short. The Wire and Cable Industry Advisory Committee, meeting in Washington, urged that publicity be given the fact that copper is still in extremely short supply—not plentiful as is popularly believed. "The copper shortage is still with us and will continue to be until we are in the first quarter of 1953," the committee emphasizes.

NPA officials doubted any possibility of abandoning CMP controls on copper as long as military, defense-supporting, and essential civilian requirements continue at present levels.

Oil Burner Backlog. The Oil Burner Industry Advisory Committee, at its October meeting in Washington, reported that lack of steel had reduced its peak-season production schedule. Although there is no shortage of domestic oil burners, the committee reported a growing backlog of orders for the heavier types used in schools, hospitals and factories.

In STATLER CENTER





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TUBULAR AND HOT ROLLED PRODUCTS

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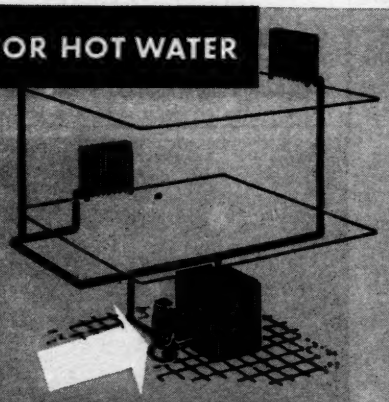
with Better-Than-Ever Engineering and Quality Control

With the consolidation of Economy Pumps, Inc. and C. H. Wheeler Manufacturing Company, the heating pumps you have always bought as "the best in the field" will now be sold as WHEELER-ECONOMY HEATING PUMPS. Representatives are being appointed in key areas to give you good service with a time-honored line of heating pumps that is now *better than ever.*

The Wheeler-Economy line of heating pumps has undergone a complete engineering check-up and reanalysis from the castings out. Many refinements have been made and a new face-lifting has been effected...

TYPES FOR EVERY BASIC HEATING PROBLEM

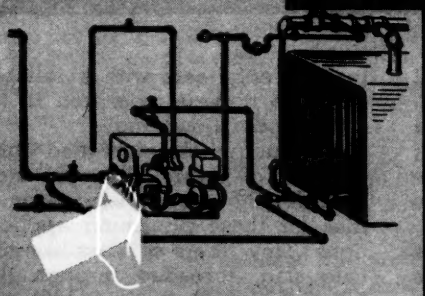
FOR HOT WATER



HOT WATER CIRCULATION

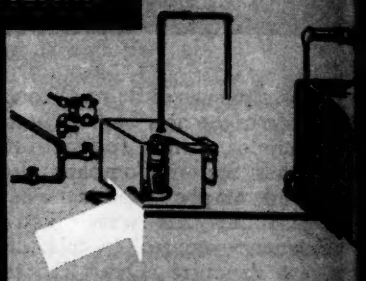
Wheeler-Economy Pumps deliver hot water to radiators quickly and return warm water to boiler with minimum heat loss.

FOR STEAM



STEAM VACUUM

The Wheeler-Economy Vacuum Producer is the most efficient design ever devised for removing air and water from condensate return lines.



RETURN CONDENSATION

Wheeler-Economy Pumps combine outstanding performance with low cost in a compact, dependable design.

WHEELER-ECONOMY HOT WATER CIRCULATING PUMPS

Type SCV—Vertical direct connected centrifugal pump. Sizes 1" to 3". Capacities to 500 GPM. Various RPM speeds 1150 to 3450. Heads to 225'.

Type SCC—Close coupled vertical or horizontal mounted. Sizes 1½" and 2". Capacities to 100 GPM. 3450 RPM. Heads to 120'.

WHEELER-ECONOMY VACUUM PUMPS

Type VV—Vertical Vacuum Pumps—Suitable for use on all ordinary jobs operating between 3 and 12 inches of vacuum. Made for all discharge pressures up to 150 lb. per sq.in. Capacity sq.ft. E.D.R. 2500 to 15,000. Single and duplex units.

Special Capacities—VVS and VVSD single and duplex units recommended wherever capacity of system or air leakage is greater than ordinary. Also where lifts or pockets in the returns necessitate carrying higher vacuum. (Example: 10 to 16 inches.)

Type SVA—Horizontal Vacuum Pumps—For ordinary jobs operating between 3 and 12 inches of vacuum. Discharge pressures up to 150 lb. per sq.in. Capacity sq.ft. E.D.R. 20,000 to 100,000. Single and duplex units.

Special Capacities—Styles SVS single unit and DVS Duplex Unit, recommended where air capacity or air leakage in the system is greater than ordinary. Also where lifts or pockets in return require the carrying of higher vacuum—example 10 to 16 inches.

WHEELER-ECONOMY RETURN CONDENSATION PUMPS

Type E—Operate at 1750 RPM or for 50 cycle current at 1440 RPM. The best pump where extremely quiet operation is desired. Single and duplex units. Capacity sq.ft. direct C.I. radiation or equivalent: 1000 to 65,000.

Type EC—Available for the same or higher pressure than handled by Type E pumps. Operate at 3450 RPM. Units for 50 cycle current operate at 2880 RPM. Capacity sq.ft. direct C.I. radiation or equivalent 1000 to 65,000. Single and duplex units.

Vertical Underground Pump—Used where returns are below floor level or otherwise too low for horizontal pumps. Cast Iron tank can be installed flush with floor. No pit required for pump. Low and medium pressure units equipped with single stage pumps of vertical design. For higher pressure units a multistage pump of special design is used. Capacity in sq.ft. direct C.I. radiation or equivalent 2000 to 50,000. Single and duplex units.

Type S—Condensation Pump with Steel Receiver—An "Economy" installation where service is not severe and heavy construction cast iron tanks are not required. Where steel receiver is satisfactory and low cost is of primary importance Type S is recommended. However, these low cost models are the equal of the top grade in many competitive lines. Single or duplex units.

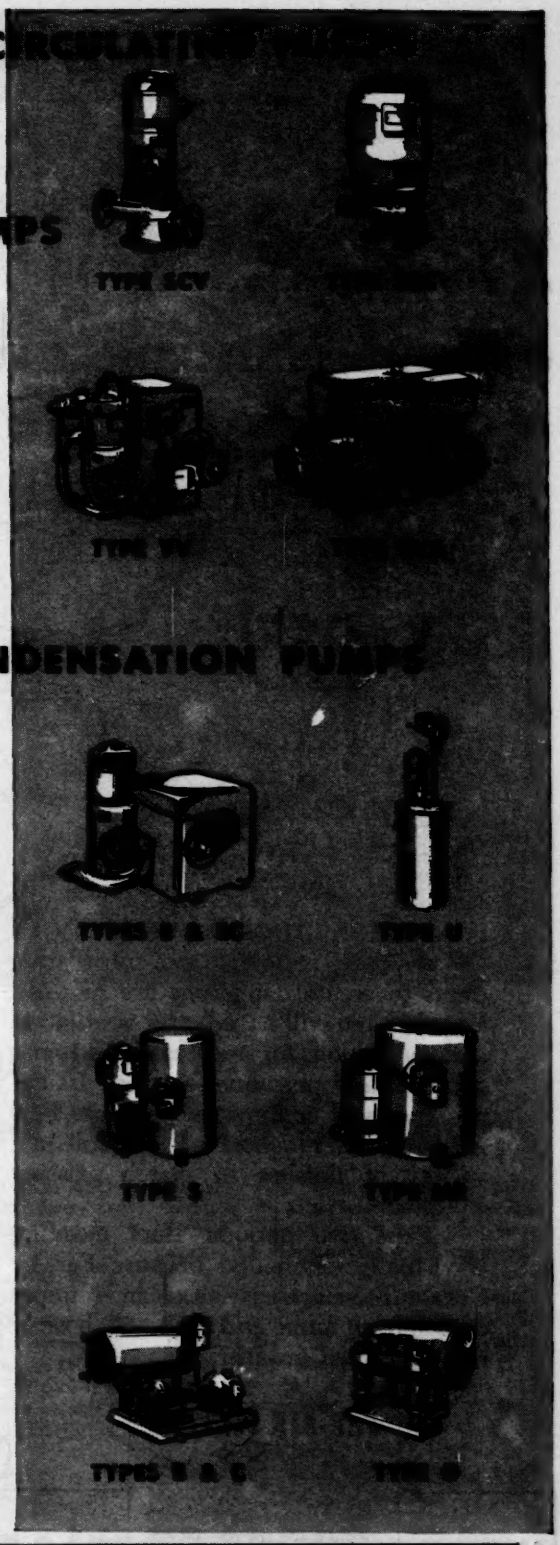
Type MR—Lightweight Pump for low pressure steam heating systems. Priced to meet competition . . . with no compromise in workmanship and materials. Capacities up to 65,000 sq.ft. E.D.R. Single and Duplex Units.

Types B and C—Horizontal Return Condensation Pumps—Type B multi-stage pump for pressures up to 150 lbs. 1750 RPM. Quiet operation. Capacities in sq.ft. direct C.I. radiation equivalent to 6000 to 65,000.

Type C multi-stage pump for pressures up to 175 lbs. 3600 RPM 60 cycle. Identical to type B except for higher speed operation. Capacities in sq.ft. direct C.I. radiation equivalent to 6000 to 65,000.

Type G—Horizontal Return Condensation Pump—Type G single suction, single stage designed for medium and high pressures at motor speeds 1800 to 3450 RPM. Receivers of all three types, "B", "C" and "G" are welded steel plate unless otherwise ordered.

All Wheeler-Economy Heating Pumps are tested before shipment and guaranteed for workmanship and materials.



SOME TERRITORIES STILL AVAILABLE FOR REPRESENTATIVES WHO QUALIFY

Over 15 million dollars' worth of these pumps are in use throughout the United States

126

WHEELER-ECONOMY PUMPS

FAR-AIR*

grease eliminators make my kitchen safer! cleaner!

HERE'S WHAT THEY CAN DO FOR YOUR KITCHEN!

Far-Air Grease Eliminators trap grease before it builds up in ventilating ducts to create dangerous fire hazards. Your kitchen will have better ventilation and sanitation for increased customer goodwill and personnel comfort. Its appearance will be improved because Far-Air Grease Eliminators are available in a variety of finishes to match existing equipment.

Expensive periodic duct cleaning is virtually eliminated because Far-Air Grease filters are easy to clean – simply detach from frame and flush with hose or run through dishwasher.

HERE'S WHY FAR-AIR FILTERS ARE MORE EFFICIENT!

Far-Air's exclusive herringbone-crimp media construction provides more efficient grease elimination, 50% more ventilation and assures a longer service period between cleanings.

Farr Engineers are available to help you with your filtration problem, show you how FAR-AIR Grease Eliminators can make *your* kitchen safer and cleaner. Fill out handy coupon below, mail today!

Other FAR-AIR equipment includes:
Standard commercial and industrial panel filters
Marine filters • Rotary coolers
Filter maintenance equipment
Special filters for special applications

*Trade Mark Reg.

FAR-AIR FILTERS

"Better by Farr"

FARR COMPANY

Manufacturing Engineers

CHICAGO · LOS ANGELES · NEW YORK

Mf'd under license by Control Equipment Co., Ltd.
Montreal, Canada

Farr Company, P. O. Box 10187 Airport Station,
Los Angeles 45, California

Please send me information on FAR-AIR Grease Eliminators. I would ☐ would not ☐ like a Farr Field Engineer to discuss my air filtration problem with me.

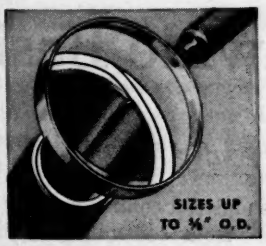
Name_____ Title_____

Company_____

Address_____

Extra-strong, lightweight coils of Bundyweld Tubing are easily mounted onto ceiling. Lying flat and straight, coils are quickly plastered over, with small chance of damage from rough handling or accidental hammer blows.

Get a head start on your competitors— with Bundyweld Ceiling Radiant Heating



Key to Low Cost

Bundyweld is the only tubing double-walled from a single strip, copper-brazed through 360° of wall contact. It's leakproof, thinner walled, yet stronger. It transmits heat quickly, has high bursting strength. It saves on material costs and installation time.

Standard 20′ or 24′ lengths of Bundyweld are easily formed into coils in shop or on job site. Expanded ends (furnished when specified) are quickly soldered into leakproof union. Joined, lightweight coils are easily mounted onto ceiling, quickly plastered over.

You can move right past local competition and stay ahead for years to come—with Bundyweld Ceiling Radiant Heating.

Here's a system that's already a big hit with thousands of enthusiastic users. They've gone on record with praise for this clean, economical and convenient way to heat homes. Just imagine telling your heating prospect that he, too, can have walls without dirt streaks, warmth that's always even, freedom from drafts, lower fuel bills.

That same prospect of yours could well be one of the millions who have already seen Bundy ads in *Better Homes & Gardens* and *American Home*. Those readers have sent in an avalanche of coupons requesting informative literature—and the names of builders and plumbing and heating contractors handling Bundyweld Ceiling Radiant Heating in their communities.

For more details, mail in the coupon below. You'll be glad tomorrow that you did it today!

Radiant Heating Division
BUNDY TUBING COMPANY
Detroit 14, Michigan

SEND FOR FREE LITERATURE!

LIKE HAVING THE SUN IN YOUR CEILING

Bundyweld Ceiling Radiant Heating

Radiant Heating Division, Dept. HV 1152
Bundy Tubing Company, Detroit 14, Mich.

☐ Send free 20-page nontechnical brochure explaining Bundyweld Ceiling Radiant Heating.
☐ Send Bundy technical radiant heating pamphlet.

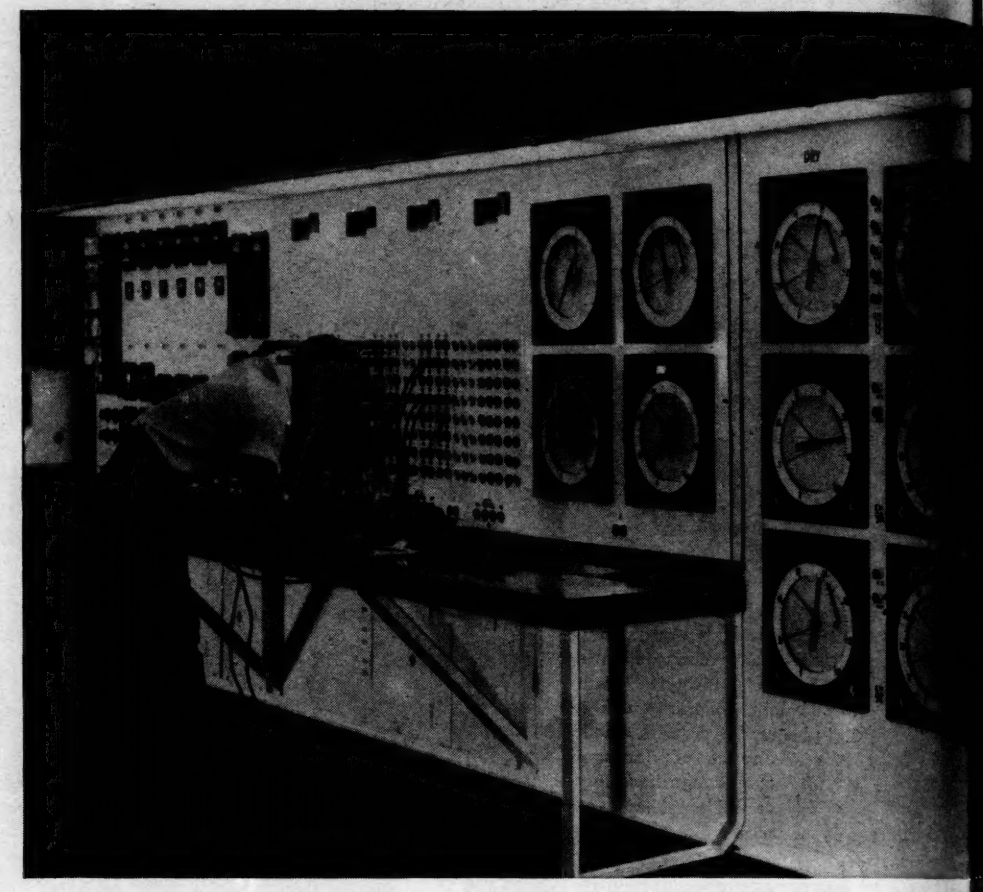
Name_____ Title_____

Company_____

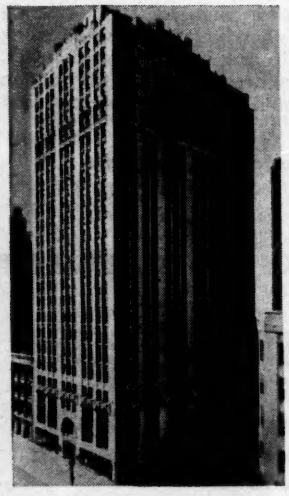
Address_____

City_____ Zone____ State_____

Indiana. Photo at right shows Honeywell Brown Instruments used for precision control in Harvester's six-room refrigeration experimental lab in the Evansville works. Instruments measure water temperature differential, control air conditioning temperature operations and humidity.



Why International Harvester Uses Honeywell Customized Temperature Control on a Nationwide Basis



Systems provide precision industrial control, help insure comfort and efficiency

If you were to take a handful of drawing pins and locate on a map all the U. S. plants and offices of International Harvester, you'd soon see how the company's facilities spread from the home office in Chicago (photo at left) to cover the entire country.

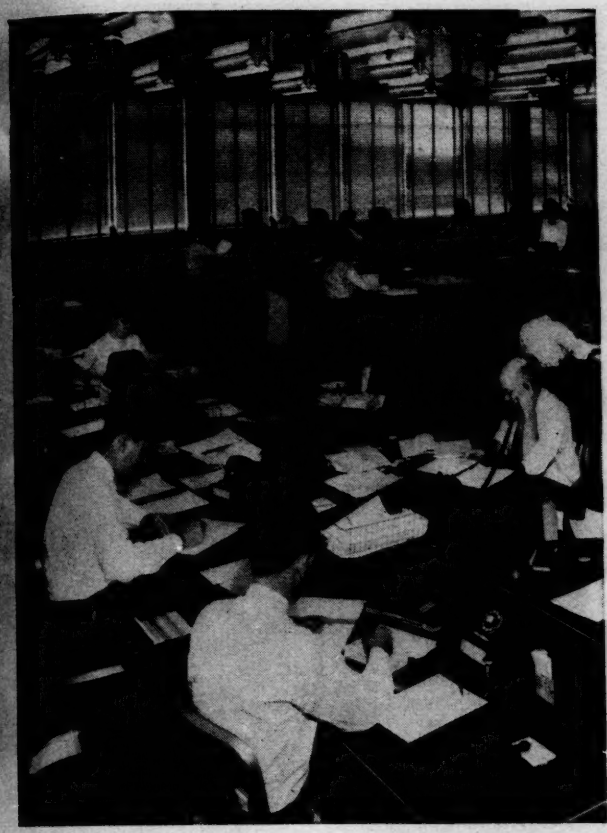
And anywhere you located a Harvester operation, chances are good that you'd pinpoint a Honeywell installation.

Because Harvester uses Honeywell Customized Temperature Control on a nationwide basis—for industrial control, and for comfort control. And with good reason.

Honeywell Customized Temperature Control is *flexible*. That means it can meet almost any industrial control problem you might name—from controlling humidity within two per cent to regulating the thickness of an oil film in terms of a thousandth of an inch.

In *comfort* applications, Honeywell Customized Temperature Control helps insure employee efficiency by providing superior indoor "climate."

And when it comes to *service*, there's always a "local Honeywell office" nearby to provide replacement parts, skilled maintenance men and control engineers to help with your planning. Because Honeywell maintains 96 offices in key cities across the nation.



Maryland. Throughout the Harvester organization, the contribution proper indoor "climate" makes to employee efficiency is well understood. Thus, in general office areas like the one above—in the company's Baltimore parts depot—you'll find Honeywell Customized Temperature Control in charge of comfort.

Oregon. Office areas in Harvester's Portland parts depot are scientifically zoned for comfort—according to occupancy, use and exposure. A sensitive Honeywell thermostat guards the comfort level in each zone. And in the warehouse area, separate controls for every unit heater are provided by the Honeywell Customized Temperature Control installation.

Iowa. Heating of warehouse areas in Harvester's Des Moines general sales and motor truck sales district office is economically controlled for maximum large-area comfort by Honeywell Customized Temperature Control. Location of unit heaters and their individual temperature controls was planned to meet occupancy, use and exposure factors.

For Comfortable, Even Temperature in New or Existing Buildings—of Any Size—Specify Honeywell Customized Temperature Control

Whether it's a factory, office, hospital, apartment, store, school, garage—or any size building—new or existing, Honeywell Customized Temperature Control can help meet your clients' heating, ventilating, air conditioning and industrial control problems.

Once equipped with Honeywell Customized Temperature Control, they'll have an ideal indoor "climate"—and save fuel besides.

And with a complete line of pneumatic, electric and electronic controls to choose from, Honeywell Customized Temperature Control offers you the greatest flexibility in design.

Then, too, when it comes to performance, Honeywell-built controls assure years of trouble-free operation. And they're backed by the finest service organization in the controls industry.

For full facts on Honeywell Customized Temperature Control, call your local Honeywell office. There are 96 across the nation. Or mail the coupon today.

MINNEAPOLIS
Honeywell

First in Controls

MINNEAPOLIS-HONEYWELL REGULATOR CO.
Dept. HV-11-232, Minneapolis 8, Minnesota

Gentlemen: I'm interested in learning more about Honeywell Customized Temperature Control.

Name _____

Firm Name _____

Address _____

City _____ *Zone* ____ *State* _____

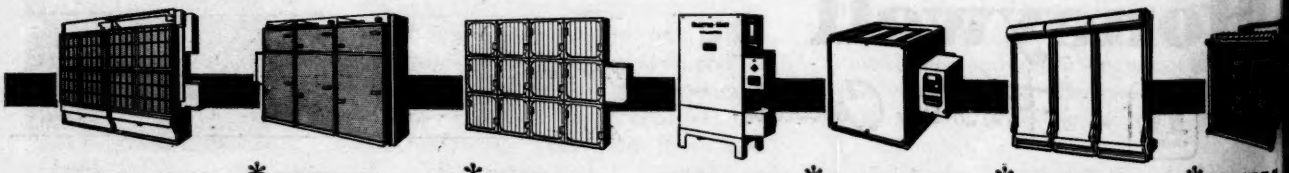
Why does AAF make

✻ AAF's ELECTRO-PL—*An exclusive development of AAF engineering research, and the only dry-type electronic air filter. The ELECTRO-PL offers these important advantages • Low initial cost • Easy installation • Simple, economical maintenance • Safety in operation • Efficient air filtration even when there are power failures.*

Above is part of the ELECTRO-PL installation providing a clean air volume of 95,000 cfm for Bell Savings & Loan Association Building, Chicago, Illinois.

Architects & Engineers: Johnson & Johnson
Mechanical Contractors: Acord Ventilating Company

a single source for all air cleaning equipment



ELECTRO-MATIC * ELECTRO-CELL * ELECTRO-PL ELECTRO-MIST * ELECTRO-KLEAN * AUTO-AIRMAT * AIRMAT PLUS

8 dry-type air filters?

THE answer is simple, but *important* to all Engineers and Executives responsible for air cleaning applications. AAF's eight different dry-type air filters were specially designed to meet the complex combination of factors that faces the engineer in solving dust and air contamination problems. Years of experimental work and thousands of individual installations have proved that at least six basic types are necessary to allow adequate latitude in specification, and to meet job requirements both practically and economically. Today, AAF's dry-type filters provide a wide range of operating and maintenance characteristics — from the AUTO-AIRMAT (fully automatic and self-cleaning) to simple replaceable units.

AAF's eight types of dry filters offer the engineer maximum flexibility in combining the following factors to fit specific job requirements:

- Cleaning Efficiency
- Maintenance Methods
- Space Requirements
- Sizes and Air Volumes
- Practical and Realistic Range of Costs

In addition to a complete line of air cleaning equipment AAF also offers the services of a nationwide engineering staff, which is recognized as the leading authority in this field. The specialized knowledge of these experts can save you time, effort and expense and is at your disposal.

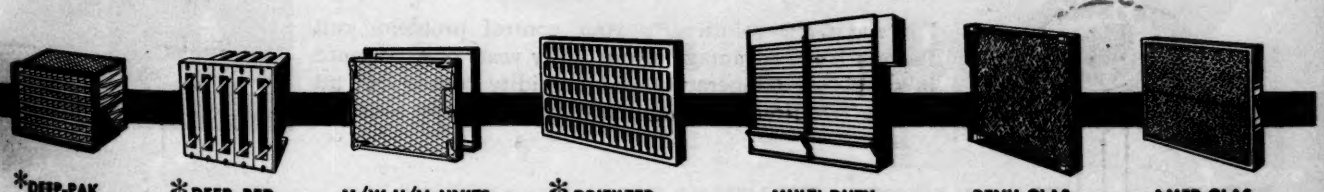
Complete engineering data is available on all AAF equipment. Contact your nearest AAF representative or write direct to us.

American Air Filter
COMPANY, INC.

294 Central Avenue, Louisville 8, Ky.

AMERICAN AIR FILTER OF CANADA, LTD., MONTREAL, P. Q.
PACIFIC DIVISION OFFICE, SAN FRANCISCO, CALIFORNIA

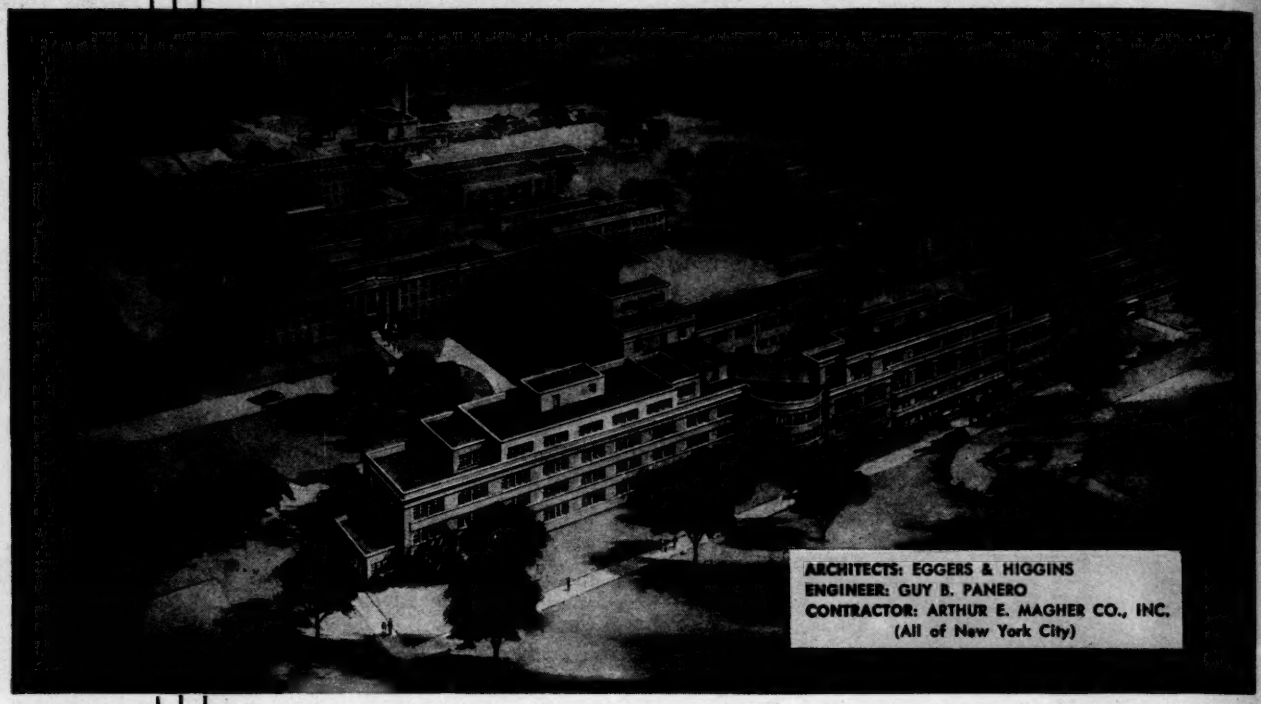
AAF



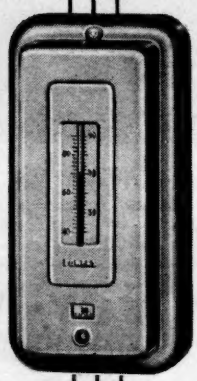
*DEEP-PAK *DEEP BED M/W-H/V UNITS *DRIFILTER MULTI-DUTY RENU-GLAS AMER-GLAS

POWERS

AIR CONDITIONING
RADIANT HEATING
HOT WATER HEATER
Control



ARCHITECTS: EGGERS & HIGGINS
ENGINEER: GUY B. PANERO
CONTRACTOR: ARTHUR E. MAGHER CO., INC.
(All of New York City)



Used in MEADOWBROOK HOSPITAL

East Meadow, Long Island, N. Y.

Modern Hospital Planning now includes greater attention to the importance of accurate control of air conditions in patients' rooms as well as operating, labor, delivery, nursery, radiograph, cystoscopy, fluoroscopy and anesthesia rooms — which are POWERS controlled at Meadowbrook Hospital.

Greater Comfort of Patients aided by Powers Automatic Temperature Control helps hasten recovery enabling them to return home sooner. Increased turnover enlarges hospital's capacity to serve more people.

Important Fuel Savings—Much higher fuel costs—a big item of expense—can be substantially reduced by prevention of OVER-heated rooms with Powers Control. Fuel savings alone make it a more profitable investment now than ever before.

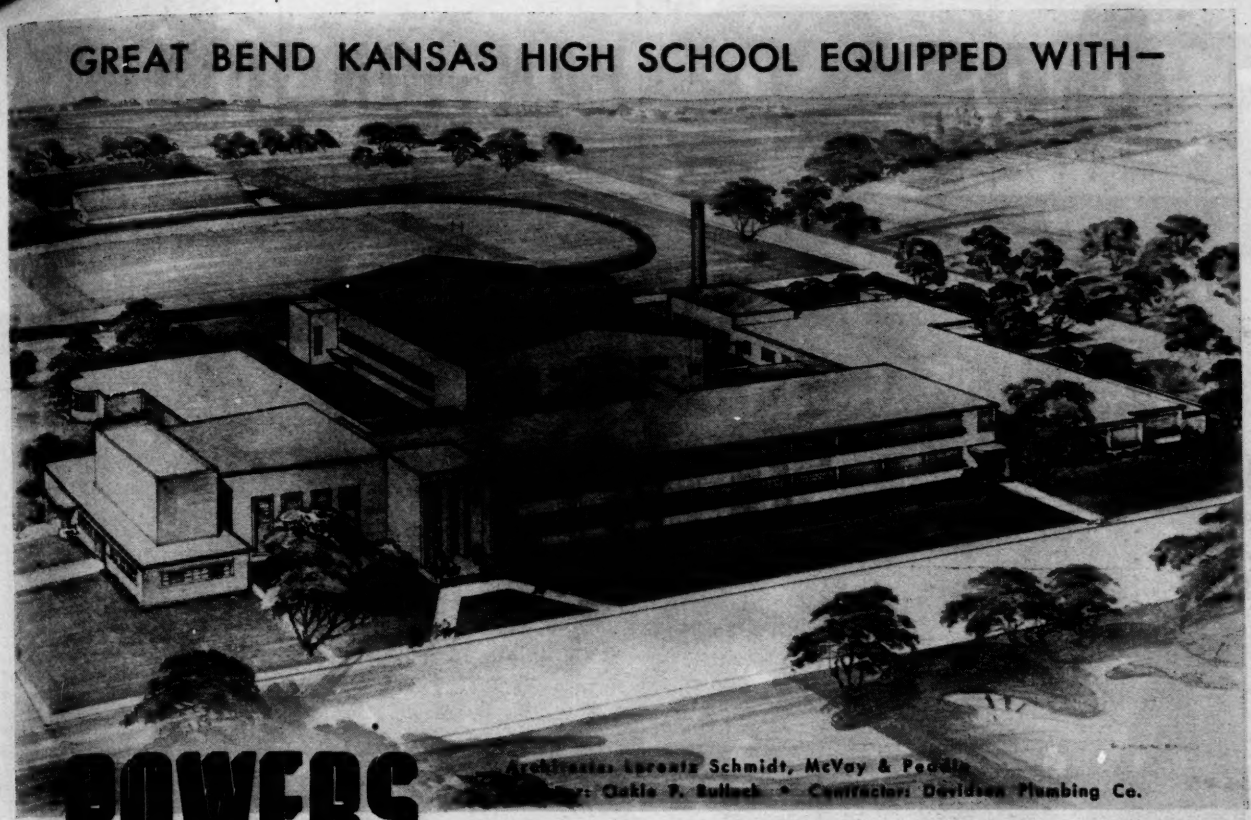
15 to 25 Years of Reliable Service with very little for repairs is often reported by users of Powers Control. It is unsurpassed for low operating and maintenance cost.

For the right solution to your control problems call Powers. Take advantage of our many years of experience in supplying temperature and humidity control for all hospital requirements, including hydro-therapy controls.

(a88)

Established in 1891 • **THE POWERS REGULATOR COMPANY** • SKOKIE, ILL. • Offices in Over 50 Cities

GREAT BEND KANSAS HIGH SCHOOL EQUIPPED WITH—



Architects: Iproniz Schmidt, McVay & Peddle
Engr: Cokle P. Bullock • Contractor: Davidson Plumbing Co.

POWERS

Pneumatic System of

Temperature Control

Assures utmost comfort and efficiency of teachers and pupils — less maintenance — bigger fuel savings.

Simplicity and Continuous Dependable Operation of Powers unit ventilator control is due to the design of its Low Limit Airstream Thermostat. Since unit ventilators operate on minimum discharge temperature much of the time the following advantages are important:

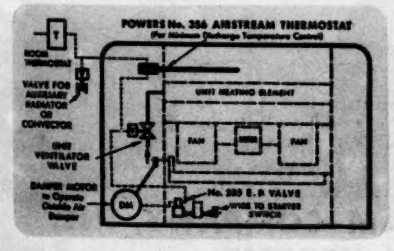
1) Powers 2-line non-waste Airstream Thermostats have a graduated dial for ease of adjustment — also Adjustable Sensitivity for precise control.

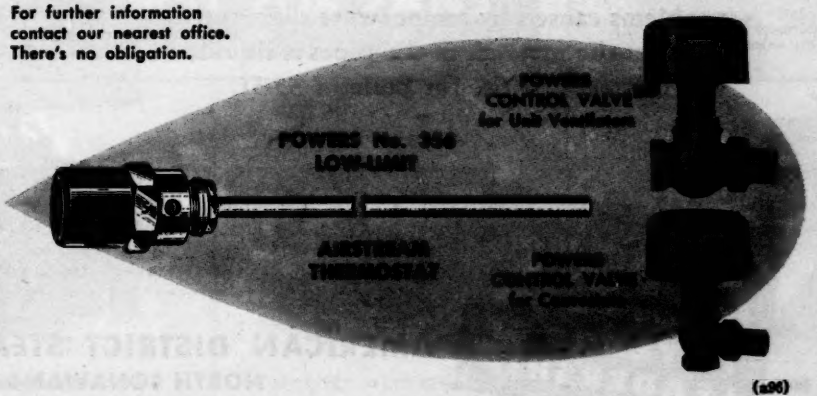
2) With its ingenious non-waste double air valve mechanism there is no continuous waste of compressed air. It is not a "leakstat."

3) Once set for the proper temperature a Powers Low Limit Thermostat requires no re-adjustment — there are no fine restrictions to be serviced.

56 Powers Day-Night Thermostats here control 81 Diaphragm Valves in Unit Ventilators and Convectors.

For further information contact our nearest office. There's no obligation.

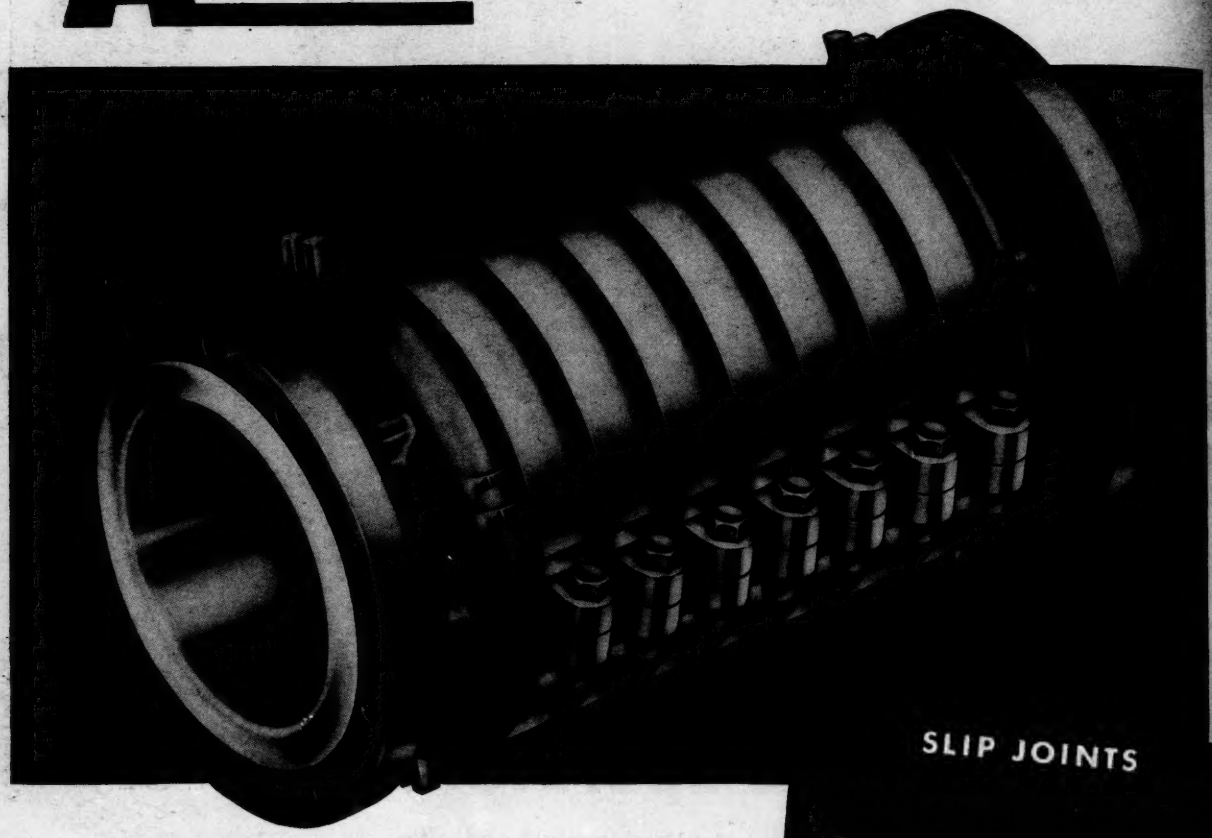



POWERS CONTROL VALVE for Unit Ventilators
POWERS No. 356 LOW-LIMIT AIRSTREAM THERMOSTAT
POWERS CONTROL VALVE for Convectors

(a96)

Established in 1891 • THE POWERS REGULATOR COMPANY • SKOKIE, ILL. • Offices in Over 50 Cities

ADSCO EXPANSION JOINTS



SLIP JOINTS

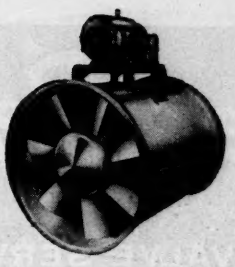
PIPE ACCESSORIES

We don't have to sell what you don't want to buy, because only ADSCO makes a complete line of expansion joints. The modern Corruflex, shown above, is the result of 50 years' experience in packless expansion joints. Equalizing and non-equalizing Corruflex joints cover wide temperature and pressure ranges and are built in many designs, including universal, tie-rod, hinge, and fully-guided. They will solve nearly all pipe-expansion problems caused by temperature differential, whether the material in the pipes is liquid, gas, or steam. Write for Bulletin 35-51.

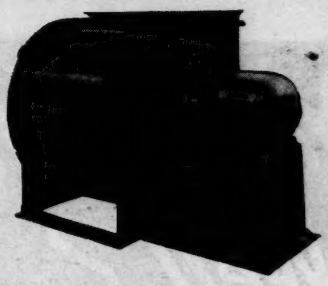
ADSCO
75 YEARS OF LEADERSHIP

AMERICAN DISTRICT STEAM COMPANY, INC.
NORTH TONAWANDA, NEW YORK

LIMIT-LOAD FANS
For large-scale ventilation. Quiet, non-overloading. Sizes up to 500,000 c.f.m. Bulletin 3737.



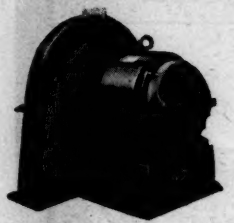
AXIAL FLOW FANS
For light-duty ventilation and air conditioning service. Compact, non-overloading. Bulletin 3533-C.



POWER PLANT FANS
Primary, forced draft, induced draft—built for the severest service. Bulletin 3750.

BREEZO FANS
Easy-to-install wall fans. Durable and very economical. 6 sizes. Bulletin 3222-F.

TYPE "CB" PRESSURE BLOWERS
For single-stage pressure blowing up to 2¼ pounds, per square inch. Bulletin 3553-A.



TYPE "CC" PRESSURE BLOWERS
In sizes for pressures up to 4 pounds and capacities up to 75,000 c.f.m. Bulletin 3553-A.

BABY CONOIDAL FANS
Compact, for portable or duct-connected service. Quiet, efficient. Bulletin 3499.

There's a "Buffalo" FAN For The Results YOU Want!

With the complete line of "Buffalo" centrifugal, axial flow and propeller fans, you can pick your fans to pin-point specifications! You can pick the *right* fan for the volume desired—for pressure to be encountered—for the conditions of heat, moisture, cold, abrasion or corrosion expected. And with every "Buffalo" Fan, you get that careful engineering and construction that always means a satisfactory job. For the exact results you want, look to "Buffalo," First for Fans.

WRITE FOR ENGINEERING BULLETINS

AND IT'S "Buffalo" FOR CENTRIFUGAL PUMPS

You'll find a full line of single and double-suction pumps to handle *your* liquids under *your* conditions. For all details, write:

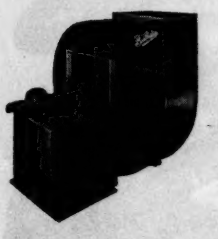
BUFFALO FORGE COMPANY and BUFFALO PUMPS, INC.
480 Broadway, Buffalo, New York
PUBLISHERS OF "FAN ENGINEERING" HANDBOOK
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Canada Pumps, Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

"Buffalo" FIRST FOR FANS

VOLUME FANS
For blowing or exhausting, up to 10" s.p. 8 discharge positions. Bulletin 3615-A.

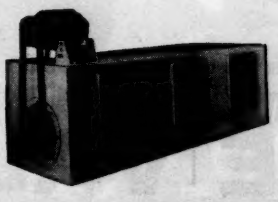
BELTED VENT SETS
Compact, "package" fans for duct or free air delivery. Non-overloading. Bulletin 3720.

"RE" BLOWERS-EXHAUSTERS
Larger versions of "Buffalo" "E" Blowers, in sizes from 50 to 1600 c.f.m., for pressures up to 40" of water.



INDUSTRIAL EXHAUSTERS
With interchangeable wheels for air exhausting or materials conveying. All-welded. Bulletin 3576.

"E" BLOWERS-EXHAUSTERS
For oil or gas furnace blowing, line boosting, cleaning. Bulletin 3014-C.

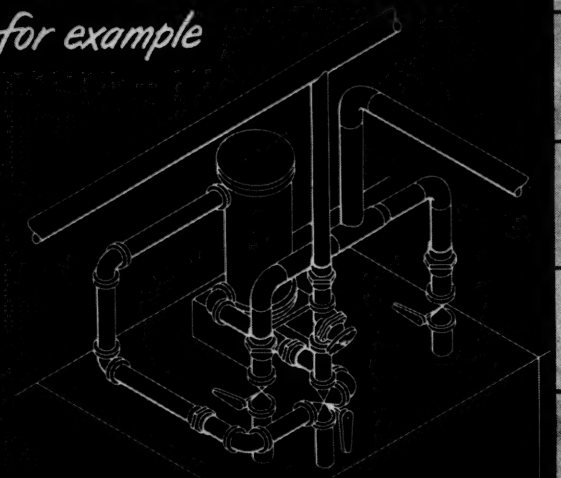


SHORTBOY VENTILATING SETS
New high efficiency all-aluminum blowers with hollow shaft. Bulletin 3701.

BELT-AIR FANS
Efficient, quiet wall fans for free air delivery up to 19,000 c.f.m. Bulletin 3222-F.

Are Your Valves Behaving This Well?

... on River Water, for example



THE INSTALLATION

VALVE SERVICE RATINGS

SUITABILITY:	Good design for gritty fluid
FEATURES:	Neoprene disc insert-resists cutting
MAINTENANCE COST:	Making big savings here
SERVICE LIFE:	Already 6 to 9 times longer than other valves
CORROSION-RESISTANCE:	O.K. no sign of corrosion
PRICE:	Better than many ordinary valves
AVAILABILITY:	Regular number in Crane line

Crane Iron Body Diaphragm Valves on hydraulic lines to cylinder operators on ash pit gates; Southwark Station; Philadelphia Electric Company.

THE HISTORY

Valves were installed in the hydraulic system when the control cocks failed to shut off tight. But like the cocks, conventional valves put in this service didn't stand up. They couldn't handle the abrasive, sandy river water used for hydraulic operators as well as for ash pit sluicing. They leaked badly in 3 to 5 weeks; had to be replaced.

The problem was solved with Crane Iron Body Diaphragm Valves. Installed more than 7 months, there's been no leakage since; no valve trouble of any kind. The Neoprene disc insert and wide, flat seating surfaces in Crane Valves show no effect of abrasion. Their completely sealed bonnet keeps working parts free of grit.

THE VALVE

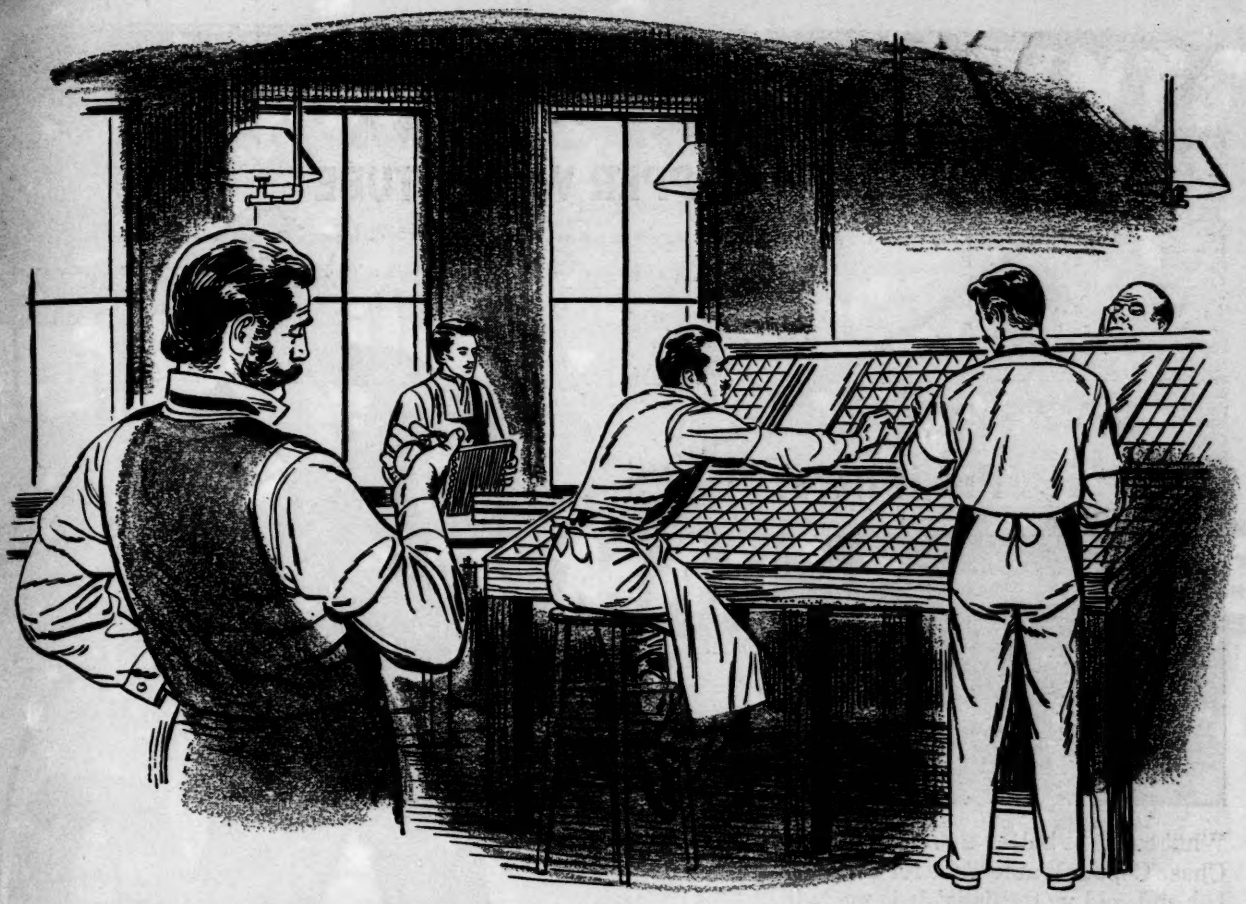
In Crane Packless Iron Body Diaphragm Valves, the Neoprene diaphragm acts as bonnet seal only; is not subject to crushing and rapid wear. Separate disc with Neoprene insert shuts off flow even should diaphragm fail. Made unlined or with full Neoprene body lining. Well suited for erosive fluids, sludges, slurries; also for many corrosive services. See your Crane Catalog or call your Crane Representative.

The Complete Crane Line Meets All Valve Needs. That's Why
More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



Up-to-the-Minute News *vs. Deadlines!*

Now, pages of type are set mechanically, in the time formerly required for just a few hand-set paragraphs. Thanks to the invention of power-driven typesetting equipment, and its ready adoption, your modern newspaper meets edition deadlines with ease and with all up-to-the-minute news.

In all walks of life electric motor power has lightened the burden of toil and made working hours more productive. Emerson-Electric experience, dating back to 1890, covers this entire era of mechanization progress. Emerson-Electric Motors bring to your product the benefits of this valuable experience plus an enviable reputation for dependability and efficiency.

Consult with us, without obligation, about motors for your regular or new products. Standard Motors are made in horsepower ratings 1/20 to 5 H.P., and Hermetic Motor parts 1/8 to 15 H.P. *Write...*

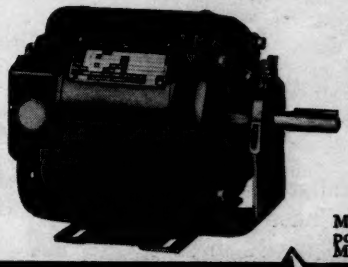
THE EMERSON ELECTRIC MFG. CO., St. Louis 21, Mo.

MODERN BUSINESS IS POWERED WITH ELECTRIC MOTORS

Write for these Emerson-Electric Motor Data Bulletins

Manufacturers requiring motors 1/20 to 5 h.p. can profitably use these reference guides. Specifications, construction and performance data are included for these motors:

- ☐ M156-A Capacitor-Start
- ☐ M156-B Split-Phase
- ☐ M156-C Integral
- ☐ M156-D Fan-Duty
- ☐ M156-E Oil-Burner
- ☐ M156-F Jet Pump
- ☐ M156-G Blower



Mergenthaler Linotypes have been powered with Emerson-Electric Motors since 1901.

EMERSON ELECTRIC
MOTORS • FANS — APPLIANCES

LEADERS IN THE MOTOR AND FAN INDUSTRY SINCE 1890

For A Better Job...

CHASE® COPPER WATER TUBE

Put it here!

What could be better than long-lasting Chase Copper Water Tube for domestic hot and cold water lines! It is made in hard and soft temper...straight lengths and long coils. Type L hard temper is especially suited for new construction. Soft temper comes in 60 and 100' coils that can be snaked behind walls and under flooring for replacement jobs.

Put it here!

For underground installations there's nothing better than Chase Type K, Copper Water Tube. Type K in soft temper can be easily bent around obstructions...it moves with the earth and settling won't harm it. Long lengths up to 100 feet in coils make few fitting connections necessary. Chase Copper Water Tube resists corrosion, does not clog with rust.

Chase® BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

• *The Nation's Headquarters for Brass & Copper*

Albany†	Cleveland	Kansas City, Mo.	New York	San Francisco
Atlanta	Dallas	Los Angeles	Philadelphia	Seattle
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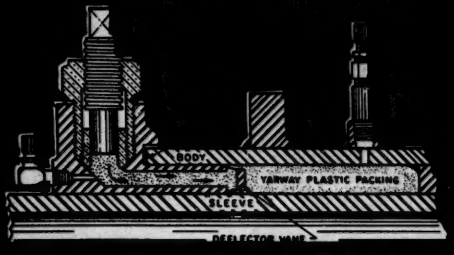
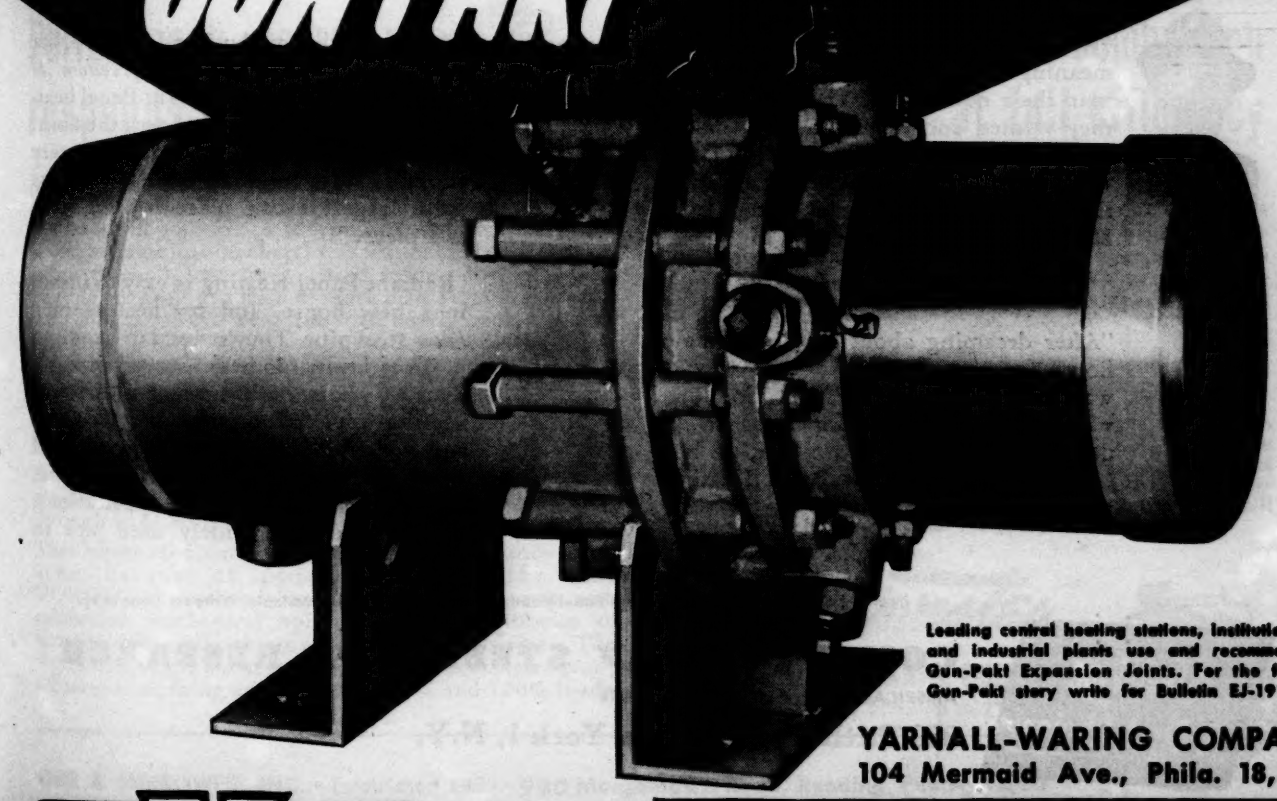
Boston	Detroit	Minneapolis	Providence	
Chicago	Houston†	Newark	Rochester†	(†sales
Cincinnati	Indianapolis	New Orleans	St. Louis	office only)

YOU NEED FEWER JOINTS

AND LESS MAINTENANCE



GUN-PAKT

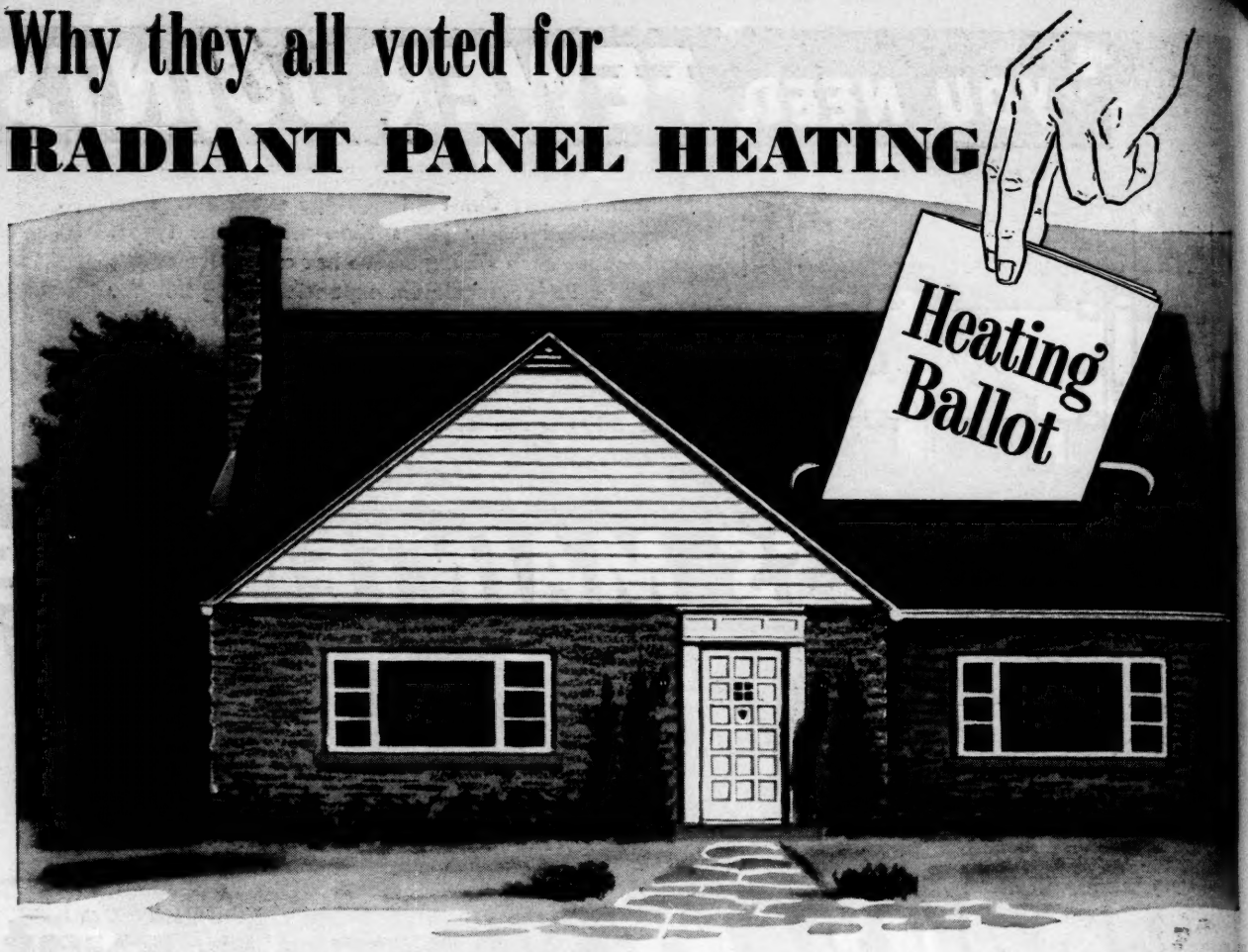


Leading central heating stations, institutions and industrial plants use and recommend Gun-Pakt Expansion Joints. For the full Gun-Pakt story write for Bulletin EJ-1912.

YARNALL-WARING COMPANY
104 Mermaid Ave., Phila. 18, Pa.

YARWAY GUN-PAKT EXPANSION JOINT

Why they all voted for
RADIANT PANEL HEATING



for the New House!

Architect

"*Keeping up with the Joneses* took on a new meaning for me when they asked me to plan their new house. They knew what they wanted and they wanted the most modern of everything. But when it came to the heating system I was way ahead of them. When I explained Radiant Panel Heating they went for it in a big way!"

Husband

"After dreaming about building a new house for years I knew exactly what I wanted in a heating system. Comfort, warm floors, uniform temperature, freedom from drafts, more vital air, no hot or cold spots. Radiant Panel Heating was the answer."

Wife

"I wanted what my husband did, too, but more than that I wanted *freedom to decorate.* Because our Radiant Panel heating *units* are concealed beneath the floor, or in the ceiling, every inch of every room is now mine to use. My rooms seem larger! I can place my furniture as I please!"

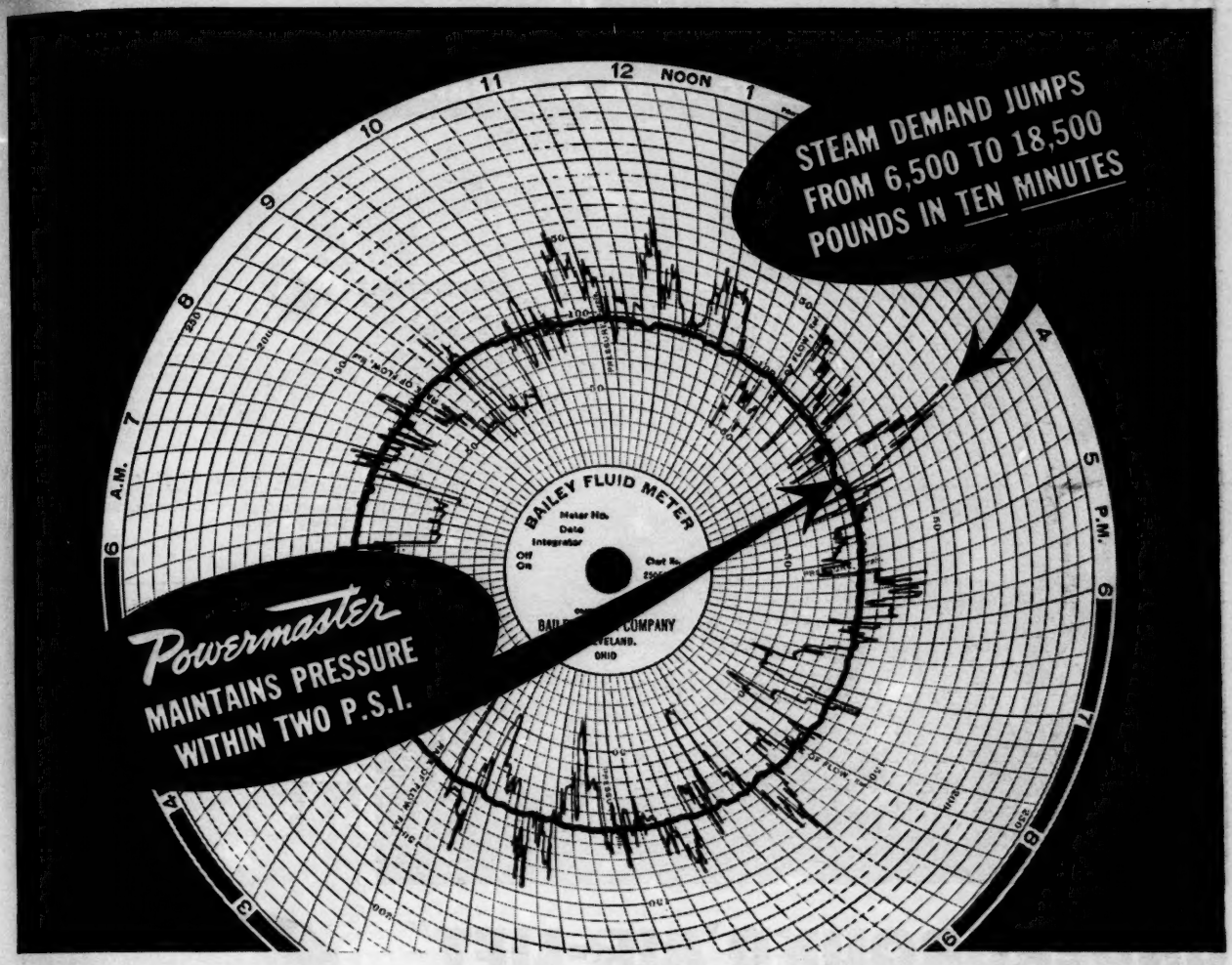
Builder

"Radiant Panel Heating is easy to install in a new house, and my heating men *know* steel pipe. They're used to handling it. They know it's been proved in more than 60 years of hot water and steam heating applications; that it's formable and weldable for fabricating coils and grids. That's why, for radiant heating, snow melting, and other applications, *steel* is the most widely used *pipe* in the world!"

A free 48 page color booklet "Radiant Panel Heating with Steel Pipe" is available. Write for your copy.

Steel Pipe is First Choice

COMMITTEE ON STEEL PIPE RESEARCH
AMERICAN IRON AND STEEL INSTITUTE
350 Fifth Avenue, New York 1, N.Y.



Performance records prove *Powermaster's* VORIFLOW combustion responds immediately to steam demand... and at full efficiency

At a large southern cotton mill, two 300 h.p. POWERMASTER boilers are generating steam 'round-the-clock at a constant pressure of 100 p.s.i. Note how evenly this pressure (blue line on chart) was maintained even though steam demand (red line) varied from a low of 3,000 pounds per hour to a high of more than 18,500. Between 3:30 P.M. and 3:40 P.M. the load nearly tripled... but the POWERMASTERS responded immediately with insignificant pressure change and no "hunting".

This kind of performance is possible because of POWERMASTER's exclusive VORIFLOW combustion. Here's what it will do for you:

1. Saves fuel by providing infinitely variable combustion modulation in response to demand—with *full efficiency*—through wide range from 30% to 100% of firing capacity.

This means elimination of waste and maintenance headaches because of incomplete combustion. The VORIFLOW air-atomizing oil burner does away with outmoded mechanical spinning devices, globules of wasted oil, and gummy cleaning problems. The VORIFLOW gas burner is an O&S pre-mix design equally efficient at all firing rates between 30% and 100% loads.

2. Slashes boiler maintenance costs.
The burner has *no* moving parts to wear out • There is *no* cup to clean daily • Routine cleaning of the burner once a month is sufficient • There is *no* burner vibration to throw adjustments "out of whack" • Parts are made of stainless steel, brass, and beryllium copper—they will last indefinitely.

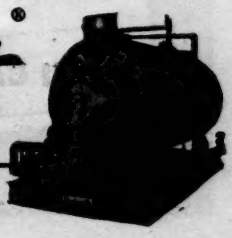
3. The combination burner permits rapid change-over from one fuel to another—light oil, heavy oil, or gas.

Before deciding on a boiler for your plant, be sure to get the facts on the newest POWERMASTER with VORIFLOW combustion. Write for this catalog that gives you the entire story of the *Powermaster* packaged automatic boiler. Just drop us a line and we'll put one in the mail for you.

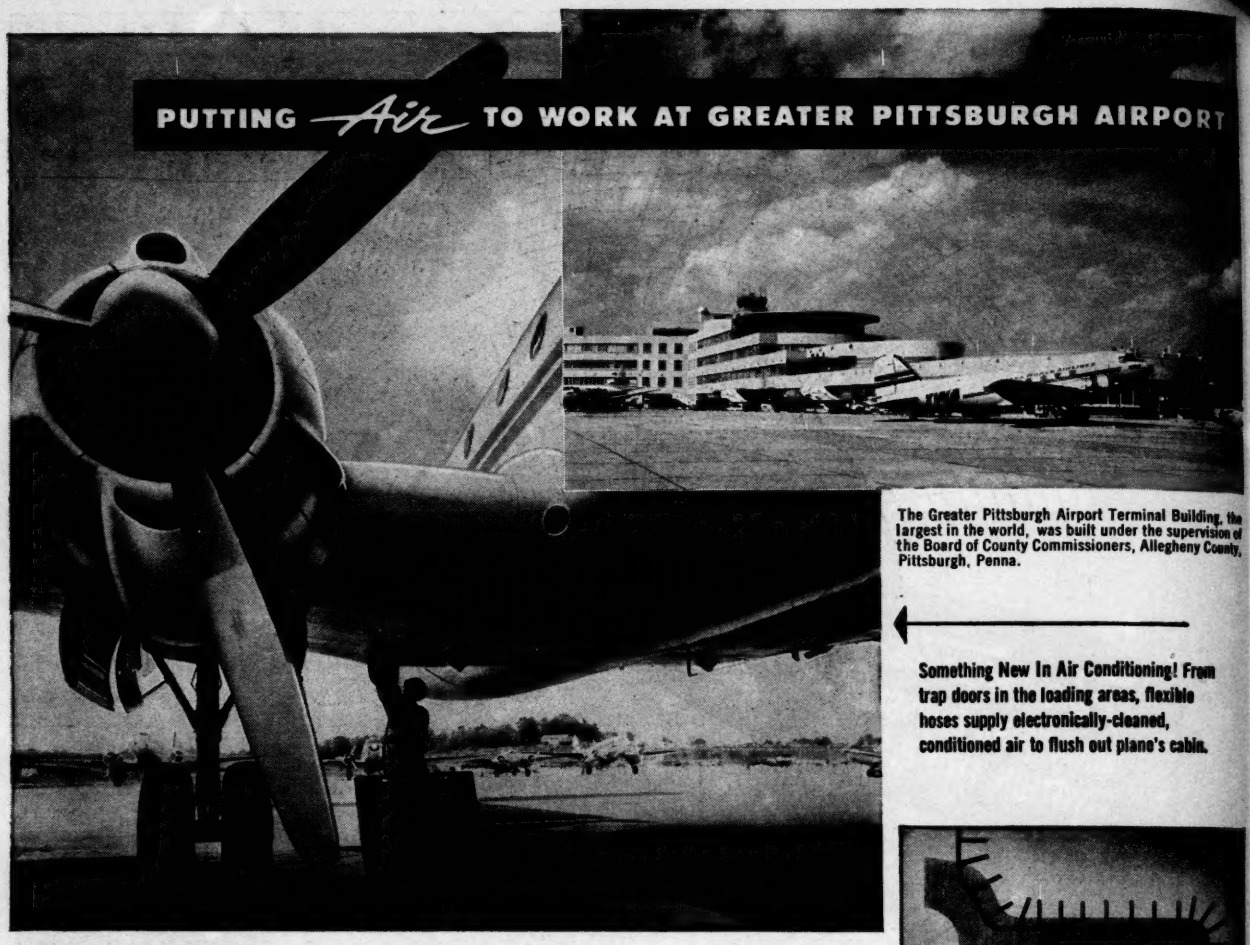
Powermaster®

PACKAGED AUTOMATIC BOILERS

In sizes to 500 HP; pressures to 250 psi.

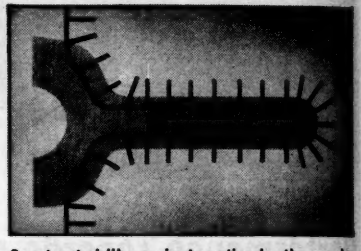


ORR & SEMBOWER, INC. • Established 1885 • **980 Morgantown Road, Reading, Pennsylvania**



The Greater Pittsburgh Airport Terminal Building, the largest in the world, was built under the supervision of the Board of County Commissioners, Allegheny County, Pittsburgh, Penna.

Something New In Air Conditioning! From trap doors in the loading areas, flexible hoses supply electronically-cleaned, conditioned air to flush out plane's cabin.



Constructed like a giant centipede, the supply system pipes conditioned air through underground ducts to loading planes. It can supply 31 planes at once.

These ducts lead to loading areas from the Precipitron in background. Dirt, pollen, germs and smog have been removed electronically.

UNDERGROUND "AIR-LIFT"

AIR CONDITIONS A PLANE A MINUTE

Now passengers waiting in planes will breathe air as clean and pure as the air at 10,000 feet. Even more, the planes will be air conditioned while on the ground. This unique feature of the world's newest and most modern airport in Pittsburgh can handle a plane a minute.

In an underground supply system Westinghouse Precipitron®, the electronic air cleaner, removes dust, pollen, smog —even germs—from the air. Westinghouse Heat Transfer Coils cool, heat or dehumidify the air as required by the weather. Result: Perfect climate inside the parked planes, year 'round.

The Terminal Building is also air conditioned. It's a small city in itself, containing 62 hotel rooms and suites, a theater, bank, post-office, telephone exchange, stores and shops. Fourteen systems serving them are equipped with Westinghouse fans, coils or Precipitron air cleaners.

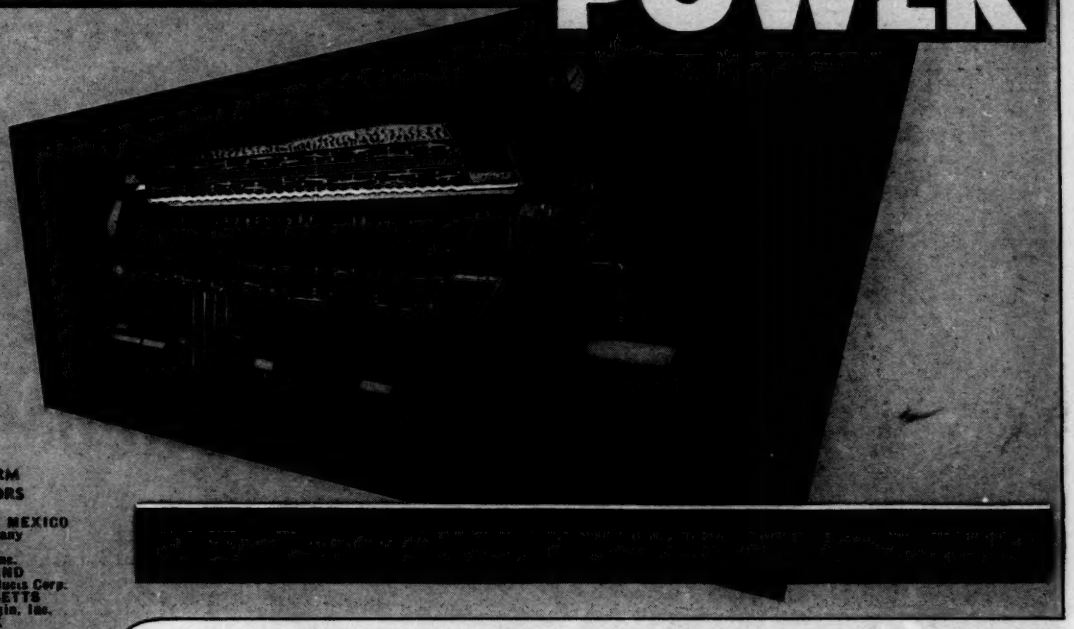
When you *put air to work*—for air handling, air cleaning or air conditioning—see Westinghouse. A complete product line matches your needs. Call your local Westinghouse-Sturtevant office, or write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

YOU CAN BE SURE...IF IT'S Westinghouse

J-80240

AIR HANDLING

66% more steam generating POWER



Cyclonic Combustion is the revolutionary new flame control that reduces heating surface requirements from 5 to just 3 sq. ft. per boiler horsepower . . . to produce 66% more steam generating power per sq. ft.

Used exclusively in Cyclotherm Steam Generators, Cyclonic Combustion controls flame characteristics in a revolving spiral vortex traveling the full length of the combustion chamber. The cyclonic flame constantly heats every part of the chamber, itself a complete heat transfer unit. 65 to 75% of the heat transfer is obtained in the chamber, with the result that only one return pass is required to deliver a guaranteed minimum efficiency of 80%.

The high efficiency of Cyclonic Combustion, plus simple compact design enables Cyclotherm generators, complete with fiber glass insulation, to save up to ⅓ the space of conventional package steam generators.

Cyclotherm generators operate on gas, oil or a combination of both. Complete combustion of fuel particles in the combustion chamber results in greater fuel savings and eliminates the need for extensive stack facilities. Inspection and cleaning is a minor operation with no time loss caused by boiler shutdown.

Cyclotherm arrives complete . . . 5 easy connections—fuel, electricity, water, steam and a simple flue—and Cyclotherm is ready to generate steam for any purpose. Full power operation from a cold start in 15 to 20 minutes. Boilers are designed for 18 to 500 h.p., 15 to 200 psi pressures.

The Cyclotherm meets all state requirements and is built in accordance with A.S.M.E. and National Board Standards and bears the label of Underwriters Laboratories, Inc.

Proved superior in thousands of installations, Cyclotherm steam generators with Cyclonic Combustion offer the most efficient and compact package steam generator on the market today. Write today for the free illustrated folder.

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EXPORT DIVISION

NEW YORK, NEW YORK
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Meet the Cyclotherm folks at Booth 15C, National Power Show, Grand Central Palace, New York City, December 1-6.

CYCLOTHERM STEAM GENERATORS

Cyclotherm Division U. S. Radiator Corp.
Dept. 27
Oswego, New York

☐ Please send without obligation my copy of "All Your Questions Are Answered by Cyclotherm."

☐ Please send a Cyclotherm representative to speak to me about Cyclotherm.

NAME_____

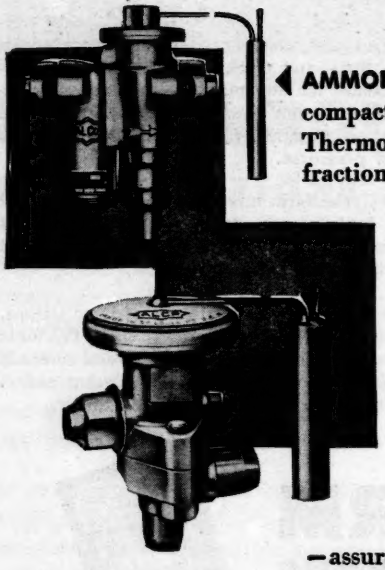
FIRM_____

ADDRESS_____

symbol of a job well done

There's an ALCO control for every application—large or small.

Installation of an ALCO VALVE assures steady, accurate refrigerant control...maximum coil efficiency... trouble-free refrigeration.



AMMONIA THERMO VALVES—have the same compact, come-apart design as all other Alco Thermo Valves. Large area strainers. From fractional tonnage to 125 tons.

"T" SERIES — for automatic liquid refrigerant control on all types of refrigeration and air conditioning systems. From fractional tonnage to 50 tons "Freon-12".

J-5 FLOAT SWITCH
—for liquid level control. Simple design. Application: Freon, Methyl Chloride or Ammonia.

MULTI-OUTLET VALVES
—assures maximum coil efficiency on multiple systems. For all refrigerants and applications: ½ to 50 tons "Freon-12"; up to 50 tons Ammonia.

SEE YOUR ALCO WHOLESALER

ALCO VALVE CO.

859 KINGSLAND AVE. • ST. LOUIS 5, MO.

Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

5218

Popular Choice
for "Packaged" Steam

- Saves Erection Time and Cost
- Meets Wide Range of Service
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

The shop-assembled B&W Integral-Furnace Boiler, Type FM, has gained industry-wide acceptance. Prominent companies in over 50 different industries, along with numerous utilities, educational institutions, hotels, hospitals, housing projects, office buildings, and government agencies have already selected this compact, self-contained steam generating unit for installations in 34 states, three U. S. territories and five foreign countries. Total steam capacity of units now in service and on order exceeds 5½ million pounds per hour. Nearly half of this capacity consists of multiple-unit applications of FM boilers instead of single larger-capacity units.

This recent B&W creation in low-cost steam generation is available in standardized sizes for loads of 2900 to 28,000 lb per hr at steam pressures to 250 psi.

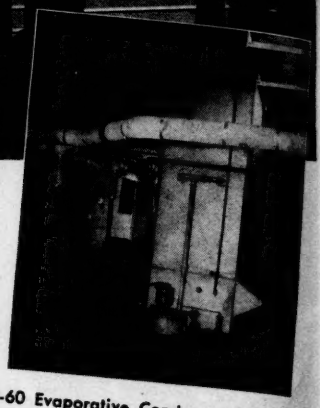
Send for Bulletin G-76 describing and illustrating the many cost-saving features of this popular boiler. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd St., New York 17, N. Y.

BABCOCK & WILCOX

G-573

VERSATILE Acme EVAPORATIVE CONDENSERS fit wide range of applications

The First Church of Christ Scientist in Birmingham, Alabama.



FP-60 Evaporative Condenser installation at the First Church of Christ Scientist.

Two recent installations of Acme Evaporative Condensers show the wide range of applications for which they are ideally suited. The ability to conserve water makes the operation very economical, while the functional design assures complete hot weather comfort.

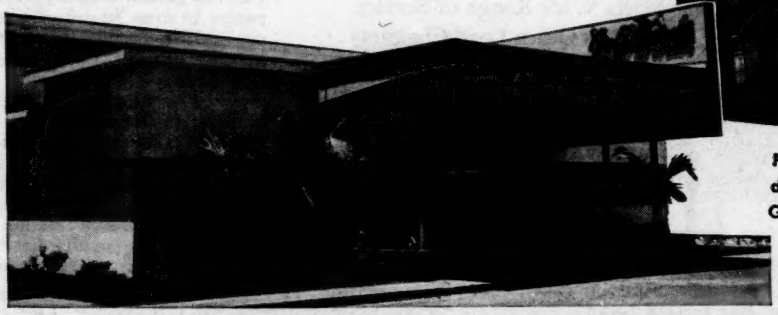
One installation was made in the First Church of Christ Scientist in Birmingham, Alabama, by the Hardy Corporation. The main auditorium seated 650 persons and a Sunday School room accommodated 148 more. Despite the variable load and Birmingham's hot climate the FP-60 Acme Evaporative Condenser has been highly efficient and completely satisfactory.

A completely different installation was made by the Krauss Heating and Ventilating Company, at the Gulf Winds Restaurant in St. Petersburg, Florida. An FP-30 evaporative condenser serving as an important component of the air conditioning system, was installed.

The air conditioning added much to the comfort of the patrons of this beautiful restaurant. Despite the unusual hardness of the water, the equipment is satisfactory in every respect, saving over 95% of the water used.

Write for more complete details on the advantages of Acme Evaporative Condensers

FP-30 Evaporative Condenser installed at the Gulf Winds Restaurant.



The Gulf Winds, popular St. Petersburg, Florida restaurant.

ACME INDUSTRIES, INC. JACKSON, MICHIGAN, U. S. A.

Air Conditioning and Refrigeration Division

CONTINUOUSLY SERVING THE AIR CONDITIONING AND REFRIGERATION INDUSTRIES SINCE 1919

TRI-FLEX and AEROVANE REGISTERS

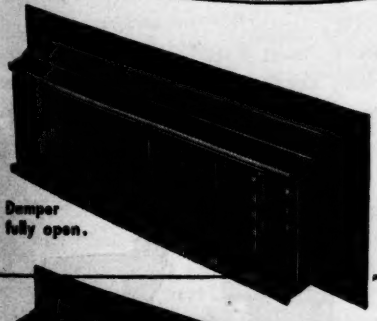
now equipped with

Opposed Blade Dampers

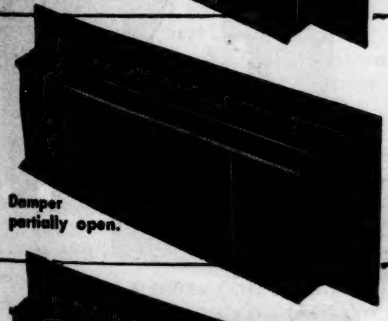
Showing TRI-FLEX T-647 Double Deflection Register with Opposed Blade Damper

KEY OPERATOR FOR OPPOSED BLADE DAMPER

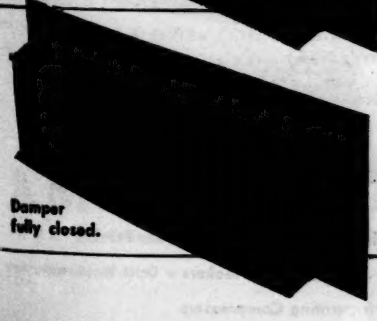
Blades are regulated by key operator which may be removed or tapped permanently into place.



Damper fully open.



Damper partially open.



Damper fully closed.

TRI-FLEX Supply Air Registers and AEROVANE Return Air Registers — specified and installed on important air conditioning jobs — are now constructed with opposed blade dampers.

This improved damper unit insures uniform distribution of air over the entire face of the register . . . and provides positive damper setting in any position from fully open to fully closed regardless of system pressure. Set in a rigid steel frame, blades are formed for extra strength and stiffness, and overlap when closed, eliminating any possibility of air leakage. Blades are regulated through the face of the register by means of a key operator which may be removed or tapped permanently into place.

For complete information and size selection-data for TRI-FLEX and AEROVANE Registers and Grilles, write for a copy of Catalog No. 200.

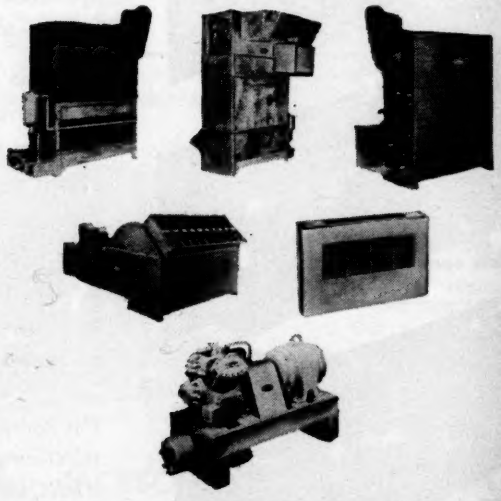
TUTTLE & BAILEY INC

NEW BRITAIN, CONNECTICUT

Ever see a better balanced family?

Careful balance is the secret behind any successful refrigeration or air conditioning installation. When compressors, evaporative condensers and air conditioning units are precisely balanced in size, quality and performance to work together with single-unit efficiency, your customers get superior performance and many *extra* years of equipment life.

Only the Carrier line of products can give you this kind of balance to work with. It's the largest family of products in the business, with a unit (or a combination of units) to meet every need, regardless of size or type of application. Carrier Corporation, Syracuse, New York.



Carrier

AIR CONDITIONING • REFRIGERATION • INDUSTRIAL HEATING

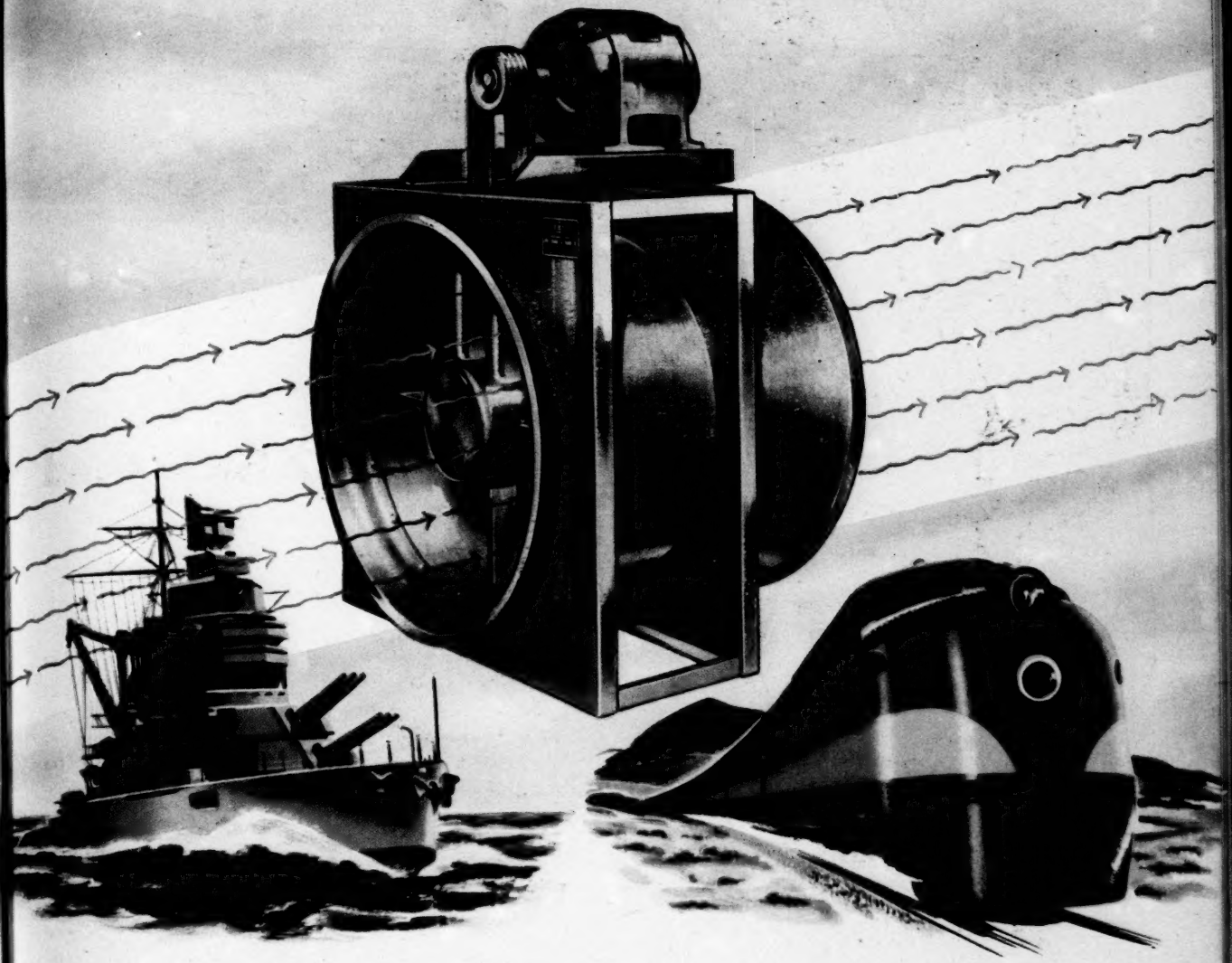
FOR 50 YEARS—THE PEOPLE WHO KNOW AIR CONDITIONING BEST

Industrial Weathermakers • Evaporative Condensers

System Weathermakers • Zoning Weathermakers • Duct Weathermakers

Refrigerating Compressors

American Blower — a time-honored name in air handling



Dependable, low cost ventilation!

The Navy demands it on battlewagons . . .

Railroads specify it for modern streamlined trains . . .

Commerce and industry require it for the conduct of profitable business . . .

No one company has done more to provide dependable low cost ventilation than American Blower.

For example, widely used in thousands upon thousands of varied applications, American Blower Axial Fans are unsurpassed for ease of installation and efficient performance.

For complete information on this and other American Blower Air Handling equipment, contact our nearest branch office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
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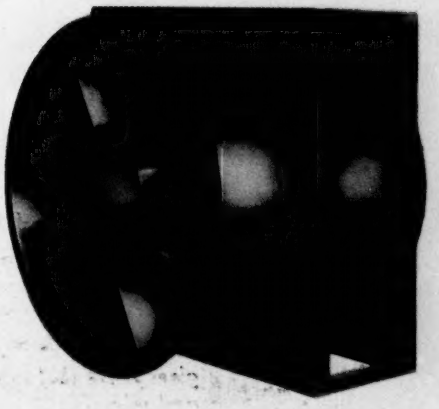
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION



American Blower Series 201 Axial Fans are smooth in performance, built for endurance and convenient to install.

AMERICAN BLOWER

YOUR BEST BUY IN AIR HANDLING EQUIPMENT

Serving home and industry

BAHCO • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

A Highly Efficient Blanket Insulation

. . . for effective control of temperature and sound

If you have a heating, refrigerating or air conditioning application that calls for an insulation with the most effective thermal-acoustical qualities, you might well ask these questions about Microlite Glass Fiber Insulating Wool:

Is it easy to apply? . . . *24 square feet of half-inch, half-pound Microlite weighs a mere 8 ounces. Large sections can be quickly and easily applied, like a downy blanket. Knife or shears are the only necessary cutting tools.*

Is it permanent? . . . *Microlite is made of glass fibers that resist fire, corrosion, moisture and vibration settling. It does not decay and provides no nutriment for fungi or vermin.*

Does it insulate well? . . . *Inch for inch, Microlite is one of the most efficient of all insulations. 1 lb. density malerial has a "k" factor of .21 at 75° F. mean temperature.*

Are convenient sizes and types available? . . . *It comes to you in resilient blankets up to 72 inches wide, up to 200 feet long, and up to 3 inches thick; compressed in easily-stored rolls. It may be ordered with foil, reflective coated paper and reinforced or unreinforced paper vapor barriers.*

Perhaps Microlite can help you cut installation costs and achieve a lighter finished application. For more information and samples, write Glass Fibers Inc., 1810 Madison Avenue, Toledo 2, Ohio.

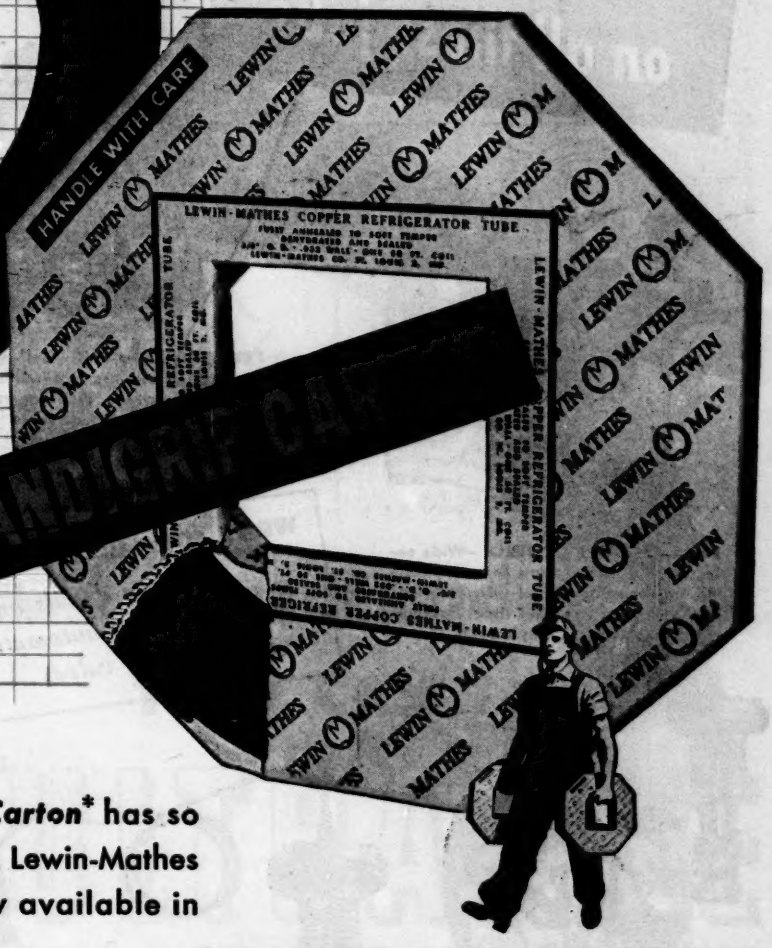
A Vitron® GLASS FIBER PRODUCT

Sales Offices and Distributors in Principal Cities

GLASS FIBERS INC.

Makers of glass fibers by the ELECTRONIC-EXTRUSION process . . . developed, patented and used exclusively by Glass Fibers Inc.

The Perfect REFRIGERATION TUBE Deserves the Perfect Package



Now in the famous HANDIGRIP CARTON*

Because the *Handigrip Carton** has so many proven advantages, Lewin-Mathes refrigeration tube is now available in this perfect package.

- INDIVIDUALLY PACKED
- SAFE PROTECTION FOR RESHIPMENT
- EASY TO HANDLE
- EASY TO STOCK
- EASY TO IDENTIFY

Only Lewin-Mathes copper tube is packed in the Handigrip Carton*

*Patent Applied For

LEWIN MATHES

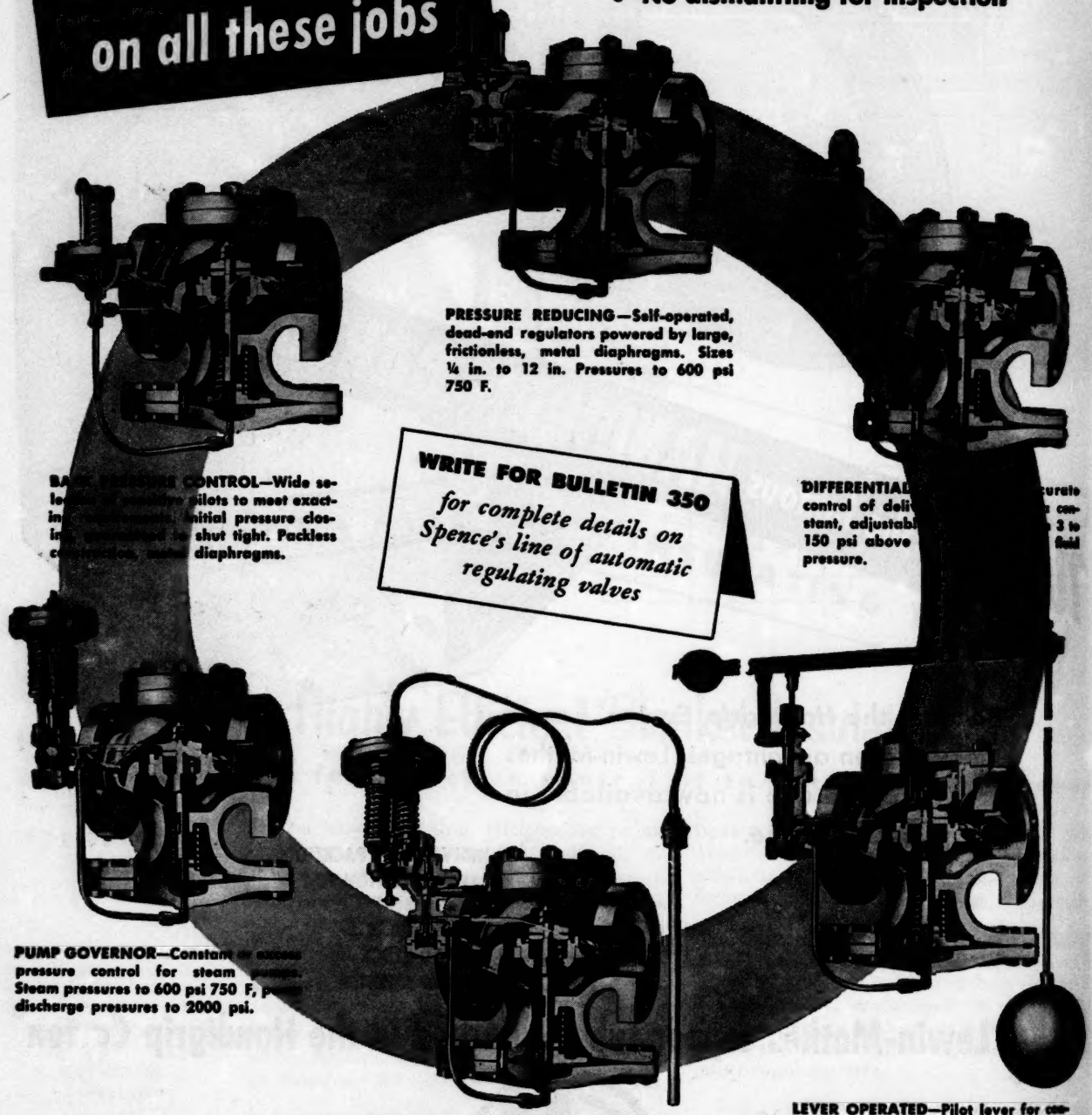
LEWIN-MATHES COMPANY · · SAINT LOUIS, MISSOURI

MANUFACTURERS OF COPPER AND BRASS TUBE, PIPE AND FITTINGS

SAVE WITH SPENCE on all these jobs

Here are a few reasons why Spence Regulators give you accurate regulation and long, trouble-free life:

- **Single-seat Packless Construction**
- **Large Balanced Metal Diaphragm**
- **Sensitive Pilots**
- **SECO Metal Seats and Discs**
- **Springs out of path of steam**
- **No dismantling for inspection**



PRESSURE REDUCING—Self-operated, dead-end regulators powered by large, frictionless, metal diaphragms. Sizes ¼ in. to 12 in. Pressures to 600 psi 750 F.

BA[illegible] CONTROL—Wide se[illegible] pilots to meet exact[illegible] [illegible]itial pressure clos[illegible] shut tight. Packless [illegible] diaphragms.

DIFFERENTIAL control of deli[illegible] constant, adjustabl[illegible] 150 psi above [illegible] pressure.

PUMP GOVERNOR—Constan[illegible] pressure control for steam [illegible] Steam pressures to 600 psi 750 F, [illegible] discharge pressures to 2000 psi.

TEMPERATURE REGULATING—Combined temperature and pressure control. No separate reducing valve required. Shuts tight, will not wiredraw or be damaged by overheating. Sizes to 12 in.

LEVER OPERATED—Pilot lever for connection by cable or mechanical linkage to floats or other devices. Slight actuator motion opens and closes main valve.

WRITE FOR BULLETIN 350
for complete details on Spence's line of automatic regulating valves

SE-113

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Spence

You can compress it...

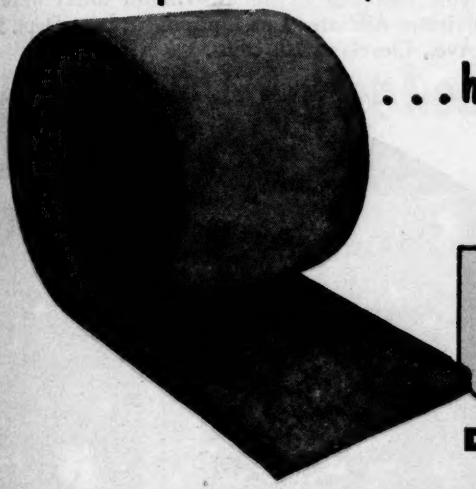
...shake it...

...wet it...

...bump it...

...bend it...

...expose it to fire...



...here's the **INSULATION**

THAT CAN TAKE IT!

ULTRALITE

DUCT INSULATION AND DUCT LINER

No other insulation can take so many kinds of punishment—*and still retain its original thermal and acoustical properties*—as ULTRALITE, the long glass fiber insulation.

Contractors and applicators who use ULTRALITE Duct Insulation and Duct Liner report that these rugged-yet-resilient insulations pay off handsomely. For example, ULTRALITE cuts application costs way down. It's easy to carry, easy to cut, quickly runs around curves and corners. It can be fastened with adhesives, wires—even staples.

Then, too, there's no waste with ULTRALITE. It won't rot, burn, chip, dent, flake, break or deteriorate with age. In the shop, or on the job, it's easy to handle, inexpensive to ship and store.

ULTRALITE Duct Insulation and Duct Liner are available plain or with a wide variety of vapor barrier facings to solve any condensation problem and to enhance the appearance of the job. Sweet's File (Architectural) Section 10 carries complete details, and local distributors in 71 cities (listed in the Yellow Pages) stock ULTRALITE to give you prompt, on-the-spot service and delivery. Call your ULTRALITE distributor—or write today for samples and full details.

GUSTIN-BACON MANUFACTURING CO.

210 W. 10th St., Kansas City, Missouri

New York • Chicago • Philadelphia • San Francisco • Los Angeles • Houston • Tulsa • Fort Worth • Detroit

Keeping pace with the Nation's industrial requirements through research and development—since 1898.

HITCH YOUR WAGON TO THIS STAR... bryant

See what you get

IN THE SENSATIONAL

bryant "327" unit heater

NOW AVAILABLE IN ALL POPULAR SIZES

FREE FOR THE ASKING! Call your Bryant distributor for your copy of this 20 page fully illustrated book which provides you with much helpful information on specifying, installing and properly locating unit heaters. This comprehensive booklet has been designed to help you.

Sets NEW Standards in...

Quiet Operation . . . NO narrow passages to cause whistling . . . it's open, streamlined—efficiently designed to HUSH the air flowing through.

Compact . . . the "327" installs within inches of ceiling, saving space. It's lighter, easier to handle, easier to install.

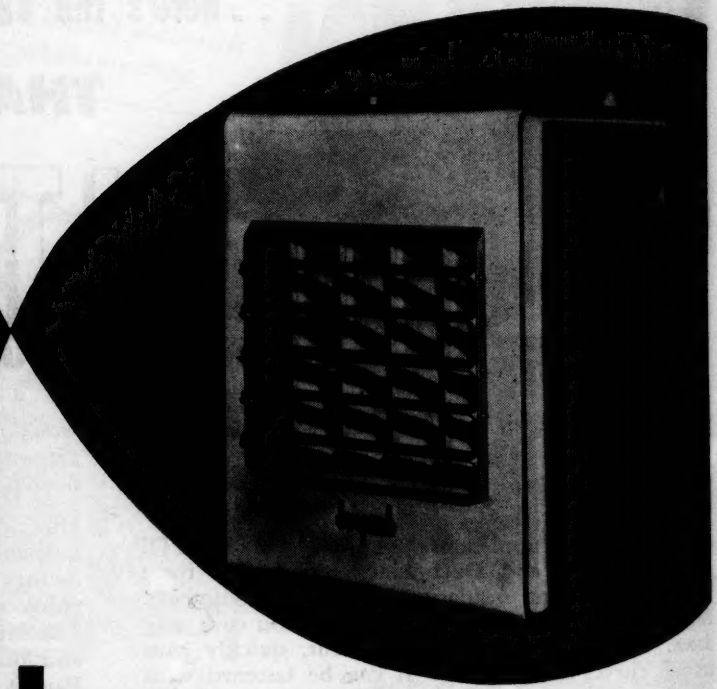
Comfort . . . no cold blasts at start of cycle. Fan won't start until the heat exchanger is warm enough to assure comforting heat.

Long, Trouble-free Performance . . . the "327" retains its high efficiency for life. Efficient Venturi tubes provide longer, trouble-free service, less heat loss up the flue.

Extra-sensitive Controls . . . responsive low-voltage controls mean better, more uniform heat. Safety controls prevent overheating.

Quick, Easy Servicing . . . easy-open access panel at bottom permits cleaning and servicing without removing unit.

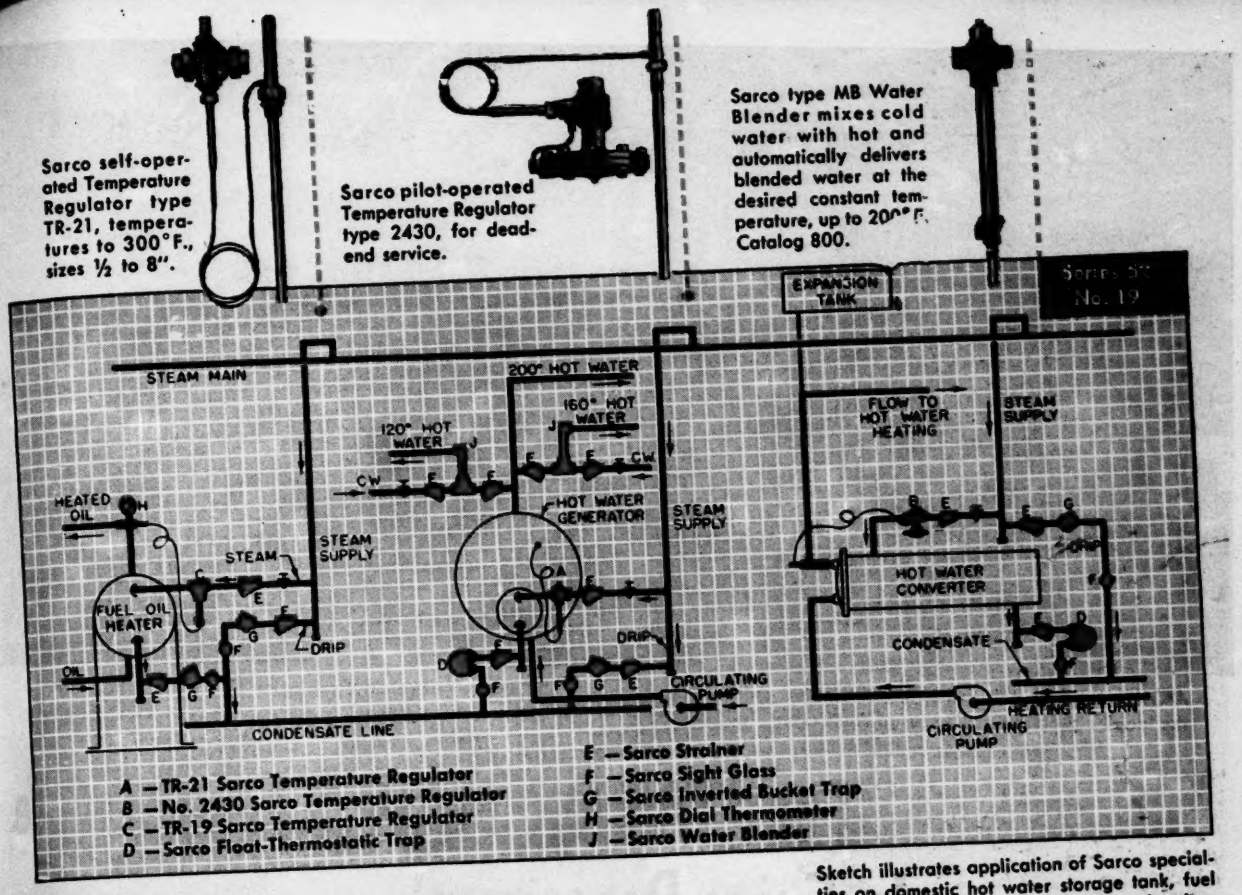
Yes, the revolutionary Bryant "327" opens up hundreds of new unit heater sales for you. See your Bryant distributor today or write Bryant Heater Division, Affiliated Gas Equipment, Inc., Dept. 148, 17825 St. Clair Ave., Cleveland 10, Ohio.



bryant®

BEST BUY IN...

HEATING
AIR CONDITIONING
WATER HEATING


Sarco self-operated Temperature Regulator type TR-21, temperatures to 300°F., sizes ½ to 8".
Sarco pilot-operated Temperature Regulator type 2430, for dead-end service.
Sarco type MB Water Blender mixes cold water with hot and automatically delivers blended water at the desired constant temperature, up to 200°F. Catalog 800.
EXPANSION TANK
STEAM MAIN
200° HOT WATER
160° HOT WATER
120° HOT WATER
HEATED OIL
STEAM
STEAM SUPPLY
HOT WATER GENERATOR
FUEL OIL HEATER
DRIP
OIL
CONDENSATE LINE
CIRCULATING PUMP
FLOW TO HOT WATER HEATING
STEAM SUPPLY
HOT WATER CONVERTER
CONDENSATE
HEATING RETURN
CIRCULATING PUMP
A — TR-21 Sarco Temperature Regulator
B — No. 2430 Sarco Temperature Regulator
C — TR-19 Sarco Temperature Regulator
D — Sarco Float-Thermostatic Trap
E — Sarco Strainer
F — Sarco Sight Glass
G — Sarco Inverted Bucket Trap
H — Sarco Dial Thermometer
J — Sarco Water Blender

Sketch illustrates application of Sarco specialties on domestic hot water storage tank, fuel oil heater and converter for space heating.

DEPENDABLE water heater control

5 POINTS TO CHECK! For hot water always at the desired temperature—never too hot or too cold—without attention,

insist on SARCO Temperature Regulators and Water Blenders

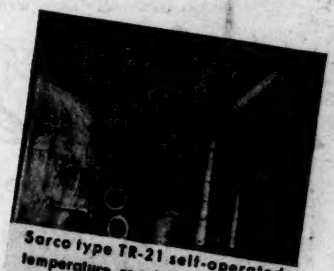
1. *Trouble-free design*—at the right are a few of the many Sarco temperature regulator installations which give years of maintenance-free operation.
2. *Self-operated* and self-contained—do not depend upon outside sources of power, such as compressed air, electricity or water.
3. *Full modulating action*—valve operated by thermostatic system *filled with oil*—which expands *uniformly* with temperature. NO dependence upon critical vaporizing temperatures of volatile fluids.
4. *Wide range of adjustment* above and below factory setting. Your choice is not limited to "standard ranges."
5. *No troublesome stuffing boxes*—Sarco *packless* seals used for valve stems. NO leaking, sticking, or repacking.

Before you buy . . . compare with SARCO

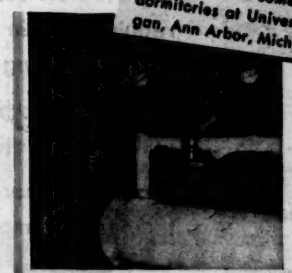
Write for Catalog 600-14 for full information on various types of Sarco Temperature Regulators and Water Blenders. Ask for a questionnaire on which you can report your exact requirements. Sarco Company, Inc., Empire State Bldg., New York 1, N. Y. Branches in principal cities. Sarco Canada Ltd., Toronto 8, Ontario.

SARCO saves steam

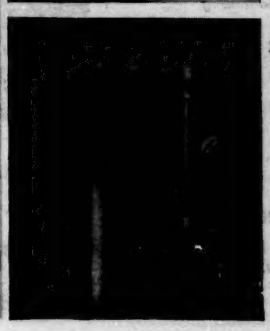
a sarco temperature control for every job



Sarco type TR-21 self-operated temperature regulators on service water storage tanks from twin heaters as installed some years ago in dormitories at University of Michigan, Ann Arbor, Michigan.

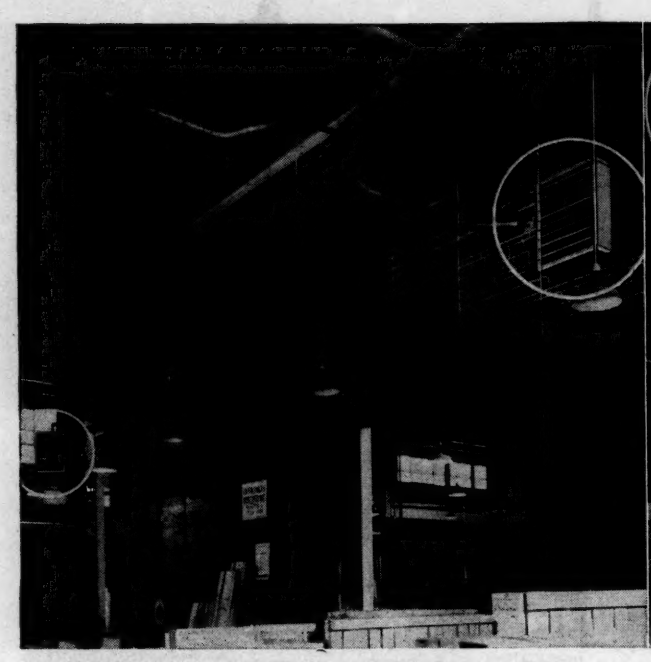


Sarco type 2430 temperature regulator on instantaneous water heater supplying water at various constant temperatures to experimental extruding machines at Western Electric Company's vast wire and cable plant at Point Breeze, Md. In use since 1948.

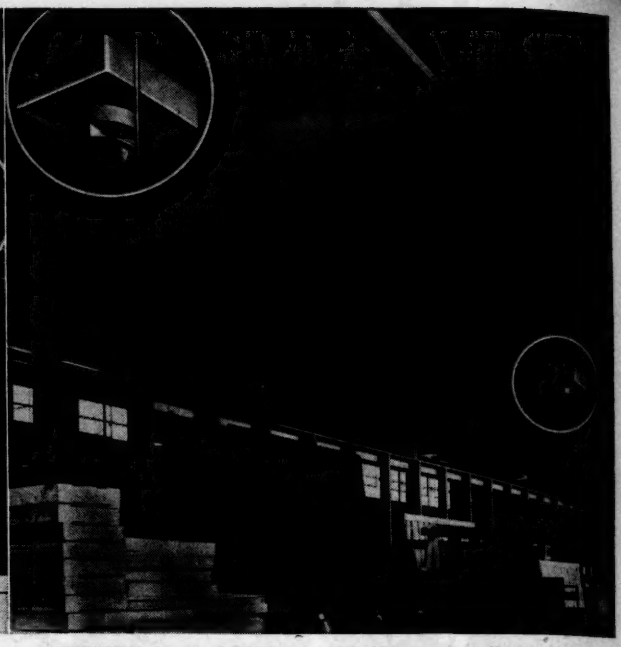


2½" Sarco Water Blender type MB as installed some years ago in the dormitories of University of Michigan to reduce washroom and shower water temperatures from 180°F., to a constant 120°F.

405



AIRTHERM Horizontal Discharge Unit Heaters installed on the loading platform of Pittsburgh Plate Glass Company.



AIRTHERM Vertical Discharge Unit Heaters installed in the Pittsburgh Plate Glass Company warehouse.

For "TAILOR MADE" Temperature In Every Department...

Airtherm STEAM UNIT HEATERS

Were Chosen for PITTSBURGH PLATE GLASS CO.

ST. LOUIS, MISSOURI

Here's another example of how the complete line of AIRTHERM Steam Unit Heaters can give you truly *flexible heating* to meet the many different requirements in factories, warehouses, garages, super markets, schools, offices, bowling alleys and similar buildings.

Horizontal Discharge Heaters are built in eleven standard and eleven low outlet temperature models, in capacities from 18,600 BTU to 270,000 BTU.

Vertical Discharge Heaters are built in seven standard and seven low outlet temperature models, in capacities from 32,300 BTU to 350,000 BTU.

Architect:
A. Stanley Knorth & Associates

General Contractor:
Woermann Construction Company

Heating and Air Conditioning Contractor:
Sodemann Heat and Power Company

Consulting Engineers:
Ferris & Hamig

Oil or Gas Direct Fired Heaters

Convectors

Centrifugal Fan Type Unit Heaters

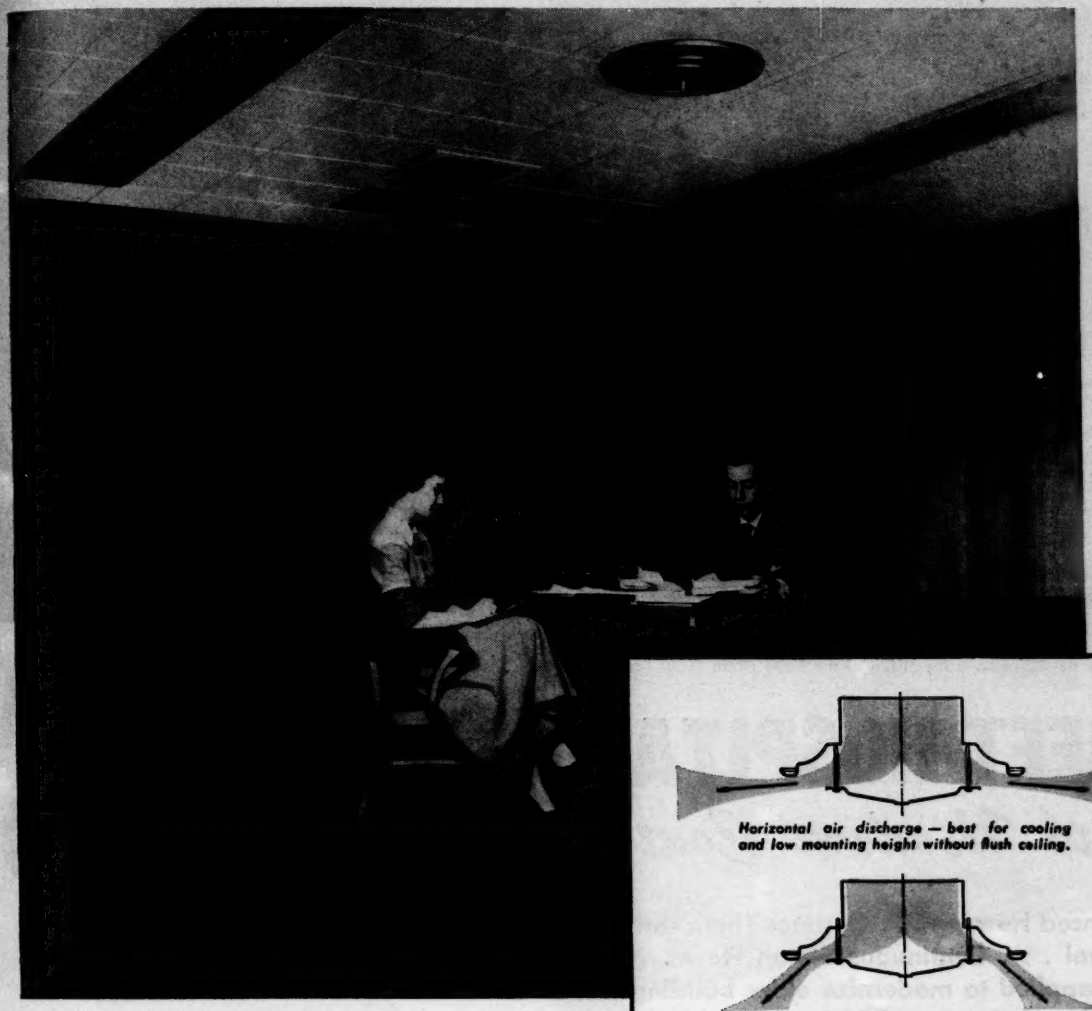
Write for Catalog 1209.

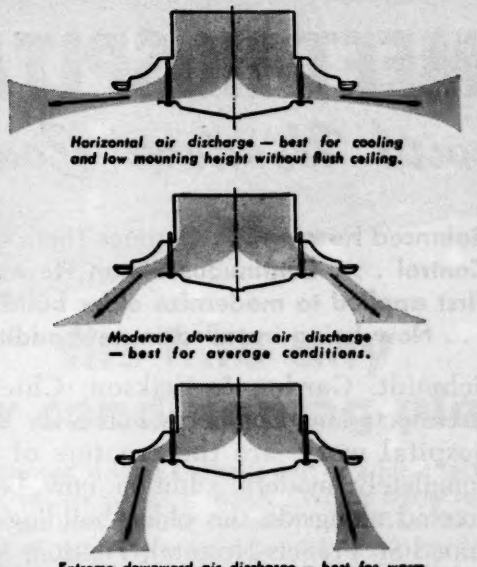
Ask your Wholesaler for Airtherm Unit Heaters.

Airtherm MANUFACTURING COMPANY

734 SOUTH SPRING AVENUE • ST. LOUIS 10, MISSOURI

Seneca Textile's new building, New York City. *Architects and Engineers:* Alfons Bach, Inc. *Contractors:* George A. Fuller Co.





Horizontal air discharge — best for cooling and low mounting height without flush ceiling.

Moderate downward air discharge — best for average conditions.

Extreme downward air discharge — best for warm air heating and high mounting without flush ceiling.

Handsome air diffusers that do a better job

With no other tool than a screw driver, you can easily and accurately adjust the air flow from a Kno-Draft Air Diffuser from horizontal to almost vertically downward—and do it *after* installation.

Think what this can mean in reducing your preliminary figuring for a job . . . and increasing customer satisfaction with the operation of the system. Kno-Draft *Adjustable* Air Diffusers are top performers under all conditions.

Yet adjustability after installation is only one of many reasons why Kno-Draft Air Diffusers are rapidly becoming the preferred units for both commercial and industrial installations.

For the complete Kno-Draft story, mail the coupon today to W. B. Connor Engineering Corporation, Danbury, Connecticut.

CONNOR

kno·draft®

adjustable air diffusers

W. B. CONNOR ENGINEERING CORP.
Dept. J-112, Danbury, Connecticut

Please send me the *new edition* of the Kno-Draft Data Book—without obligation, of course.

Name.....

Position.....

Company.....

Street.....

City..... **Zone**..... **State**.....

St. Francis Hospital, Trenton, N. J. The new $3,000,000 8-story addition, shown at left, is now under construction. Architects and Engineers: Schmidt, Garden & Erikson, Chicago. Heating Contractor: Wm. F. Hindley Co., Trenton. Operation of St. Francis Hospital is under the direction of the Sisters of the Third Order of St. Francis.

MEET HOSPITAL REQUIREMENTS

with Modern Controlled Steam Heating

Balanced Heating . . . Outdoor Thermostat Control . . . Continuous Steam Flow . . . First applied to modernize older buildings . . . Now being installed in new addition.

Schmidt, Garden & Erikson, Chicago Architects and Engineers noted for their hospital work, are the creators of the completely modern addition now being erected alongside the older buildings of famed St. Francis Hospital, Trenton, New Jersey. This new addition will have modern controlled steam heating incorporating the proven principles adopted in modernizing the original vacuum heating installation in the existing buildings.

The three original buildings, the most recent completed in 1927, were overheated, indicating fuel waste and involving considerable maintenance. In 1949 the original system was changed to a Webster Electronic Moderator System by John G. Carr Co., Inc., Trenton heating contractor.

Reporting results, Chief Engineer A. P. Scharer said that the modernization was paid for out of fuel oil savings in less than two years. Further, these older buildings are comfortably heated, with a noticeable absence of overheating in mild weather.

Is your hospital in need of modernization? It will cost you nothing to investigate. There are Webster representatives in 65 cities experienced in working with owners, architects, engineers and heating contractors in the solution of specific heating problems. Ask to see your Webster Representative.

Address Dept. HV-11

WARREN WEBSTER & COMPANY

Camden 5, N. J. Representatives in Principal U. S. Cities

In Canada, Darling Brothers, Limited, Montreal

WEBSTER

MODERATOR

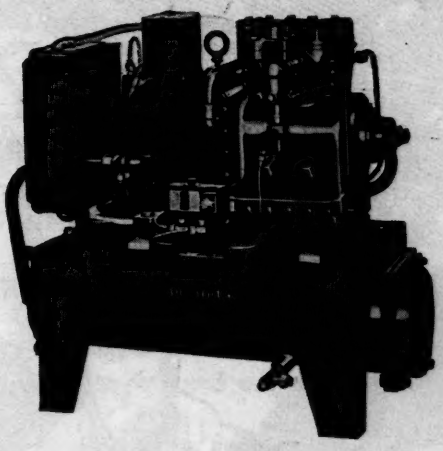
SYSTEM

OF STEAM HEATING

"Controlled by the weather"

COPELAMETIC

THE *Accessible* HERMETIC

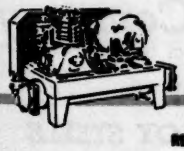


fits into any air conditioning plan

Cutaway of 7½ H.P. COPELAMETIC Motor-compressor

Whether it's a room air conditioner, a large package unit or a huge factory system, COPELAMETIC is your answer to the question "Which refrigeration unit shall I recommend for the air conditioning system?" COPELAMETIC has become the standard of comparison for dependability, ruggedness, compactness and long life. Your clients will appreciate the COPELAMETIC design which eliminates belts, seals and manual oiling . . . reasons for 9 out of 10 service calls. Better yet, they'll appreciate the practical feature of accessibility.

Air-cooled, remote COPELAMETICS are built from ¼ thru 3 HP. There are also water-cooled, remote units from ⅓ thru 7½ HP. Self-contained COPELAMETICS are available for all applications. Write for Condensed Catalog C-52.



REFRIGERATION UNITS
(OPEN TYPE AND COPELAMETIC)
WATER COOLERS

Copeland
DEPENDABLE *Electric* REFRIGERATION

COPELAND REFRIGERATION CORPORATION, SIDNEY, OHIO

Why Burn Down Your House for Roast Pig?

IN ancient China, men ate meat raw. But one day, while Ho-ti the swineherd gathered mast for his hogs, his stupid son Bo-bo, playing with fire, burned down their straw hut. Bo-bo sniffed the odor of burnt pig. He touched one to see if it was still alive, scorched his fingers, put them in his mouth and was amazed at the delicious taste. Father came home and caught his son devouring a pig. Ho-ti tried one, too, found it intoxicatingly sweet and satisfying.

Thereafter, neighbors observed feverish building of new straw huts at Ho-ti's, followed always by conflagrations. The secret leaked and fires became widespread. In a few weeks even his Lordship's town house was on fire. Finally, straw for hut building disappeared from the market and young pigs could not be had for love or money. At last, after many generations, a wise man arose who said that a pig could be roasted without burning down an entire house.

Thousands of years later, we Americans feast deliriously on "roast pig." Accompanying our delights are fires of inflation, which can destroy our values just as certainly as the roasting of Ho-ti's pigs consumed his earthly possessions. But surely we need not await the coming of a sage to tell us not to burn down our houses to enjoy the delights of roast pig!

Let us unite to stop the ruinous flames of inflation. Curb wasteful and unnecessary government spending. Balance our Federal budget. Control our national debt and reduce taxes. Only in this sane way can we produce more straw and enjoy our houses, raise more pigs and eat them, too.

QUALITY YOUNGSTOWN SERVICE

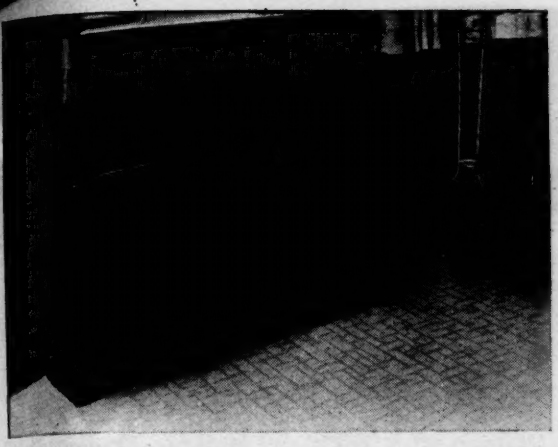
The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio

Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

RAILROAD TRACK SPIKES - CONDUIT - HOT AND COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RODS - SHEETS - PLATES.



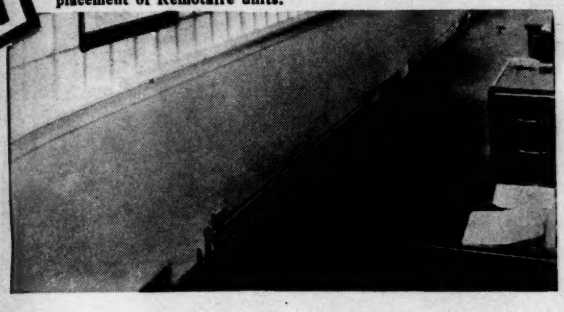
Summer cooling... winter heating

MODERNIZATION
made easy with
THE REMOTAIRE

an individual room, remote type unit providing year 'round air conditioning

1

Actual installation scene in large industrial office building showing arrangement of piping and ventilation aperture before placement of Remotaire units.



2

View of Remotaires with front covers removed. Large open area such as this can be partitioned into small offices, each with an individually controlled Remotaire unit.

3

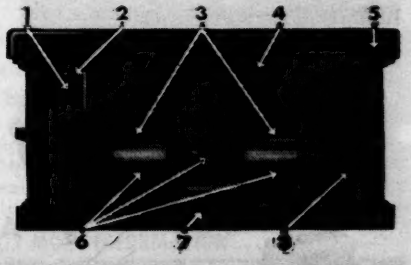
View of building showing ventilator apertures as they look from the street. Ventilation air can be supplied by several other methods, if desired.

THE Remotaire by American-Standard provides efficient, economical all-weather air conditioning for hotels, motels, apartments, schools, office and industrial buildings, and other types of multi-room installations.

The Remotaire is ideal for new construction as well as modernization. It uses chilled water from a central water chiller for cooling and warm water from a central heating plant for heating. Ventilation comes from a small wall aperture behind each unit, thus eliminating use of large, expensive, space-consuming ductwork. For descriptive literature, write for Form No. 298. **American Radiator & Standard Sanitary Corporation,** Dept., HV-112, Pittsburgh 30, Pa.

Designed for simplified economical installation . . .

1. Four standard control packages are available.
2. Coil designed for right or left hand connections. Easily reversed if necessary.
3. Exceptionally quiet fans and acoustically-treated air passages.
4. Coil shield over the top of coil prevents foreign matter from falling into coil.
5. Cabinet of reinforced furniture steel—plus a reinforced air grille—adds to permanence and long-lasting beauty of unit.
6. Fans and motor on single mounting plate permit easy removal if necessary.
7. Ventilation can be adjusted with the fresh air damper located in each unit.
8. Spacious end compartments provide easy installation and allow more than 90° horizontal wrench swing.



AMERICAN-Standard
HEATING-COOLING

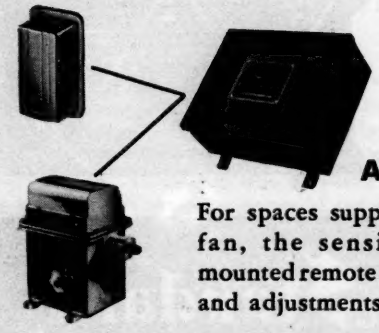
Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

here's valuable data...

- SUPER-SENSITIVE
- INSTANT RESPONSE
- RUGGED PLUG-IN ELEMENT
- EASILY INSTALLED
- ADJUSTABLE DIFFERENTIAL
- POSITIVE STABILITY
- SIMPLE ADJUSTMENTS

TWO-POSITION OR PROPORTIONING
HUMIDIFYING OR DEHUMIDIFYING
FOR *PROCESS* OR *COMFORT* CONTROL

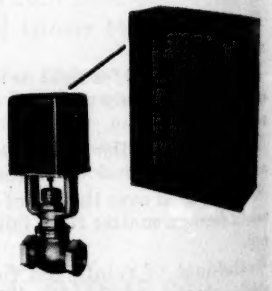


REMOTE ELEMENT APPLICATIONS

For spaces supplied by a central fan, the sensing element is mounted remote from the amplifier and adjustments.

ASPIRATING CONTROL

For use in those areas not completely air conditioned, the sensing element is mounted in a fan-fed sampling chamber.



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BARBER COLMAN

BARBER-COLMAN COMPANY

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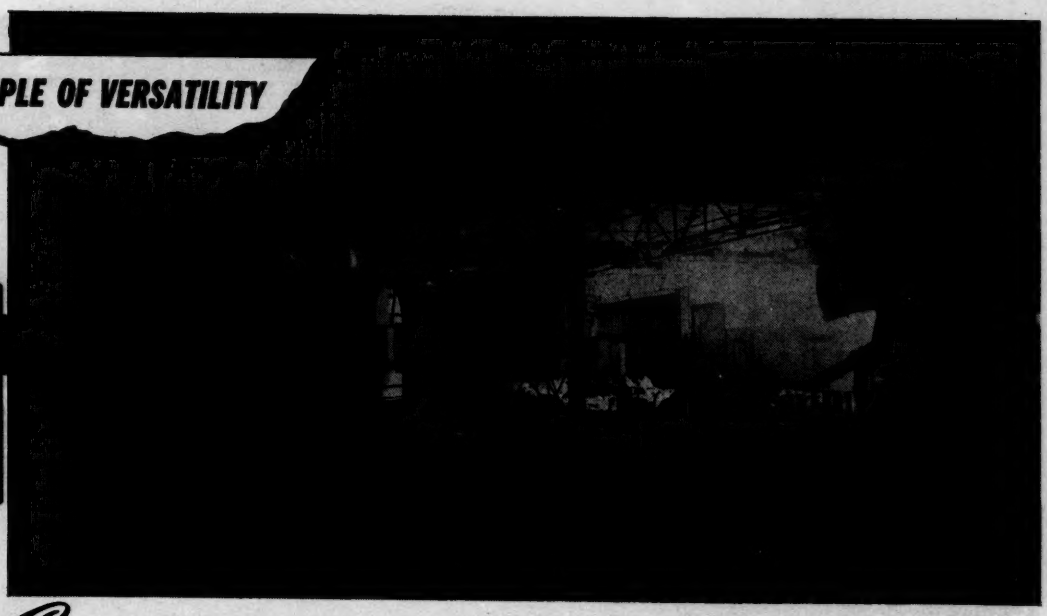
ANOTHER EXAMPLE OF VERSATILITY



DRAVO *Counterflo* HEATERS DO DOUBLE-DUTY FOR FORD MOTOR COMPANY CONSTRUCTION PROJECT

Construction of the new Ford Motor Company Engine Plant in Cleveland called for temporary heating during the winter months of 1950-51 so the building schedule could be maintained. Six Dravo Heaters were installed to serve a two-fold purpose:

COMFORT HEATING—The Dravo Heaters maintained a 40° F. temperature inside a 405,000 sq. ft. area when outside temperatures were 0° F. . . . operated 24 hours per day . . . distributed and recirculated heat throughout the working area with a maximum air throw . . . eliminated the need for salamanders or bonfires to keep workers warm, thereby reducing fire hazards.

PROCESS CURING OF CONCRETE—The Dravo Heaters kept the ground from freezing so concrete could be poured during sub-freezing weather. Heaters helped cure concrete quickly . . . were easily moved to any location to fit job requirements.

DRAVO HEATERS OFFER YOU . . .

LOW INITIAL COST—users report 30% to 60% savings.

EASY INSTALLATION—fuel, electrical and exhaust connections are only requirements . . . no duct work.

LOW FUEL CONSUMPTION—burns gas or oil . . . readily converted . . . direct-fired.

QUICK HEAT—fast warm up . . . heat starts when heater is turned on.

LISTED-APPROVED—listed by Underwriters' Laboratories, Incorporated . . . approved by American Gas Association . . . acceptance by Factory Mutual Engineering Division of Dravo standardized safety control circuit.

AUTOMATIC CONTROLS—on-off or modulating controls.

MOBILITY—can easily be moved to any location to suit requirements.

FLEXIBILITY—can be mounted horizontally or vertically on ceiling, walls or floor.

LONG SERVICE LIFE—stainless steel combustion chamber eliminates refractory lining.

DRAVO

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MAIL THIS COUPON FOR MORE INFORMATION . . .

DRAVO

Heating Department, Dravo Corporation
Dravo Building, Fifth and Liberty Avenues
Pittsburgh 22, Penna.

I would like more information about Dravo Counterflo Heaters. Please send me Bulletin No. VW-523-354

Name_____

Title_____

Company_____

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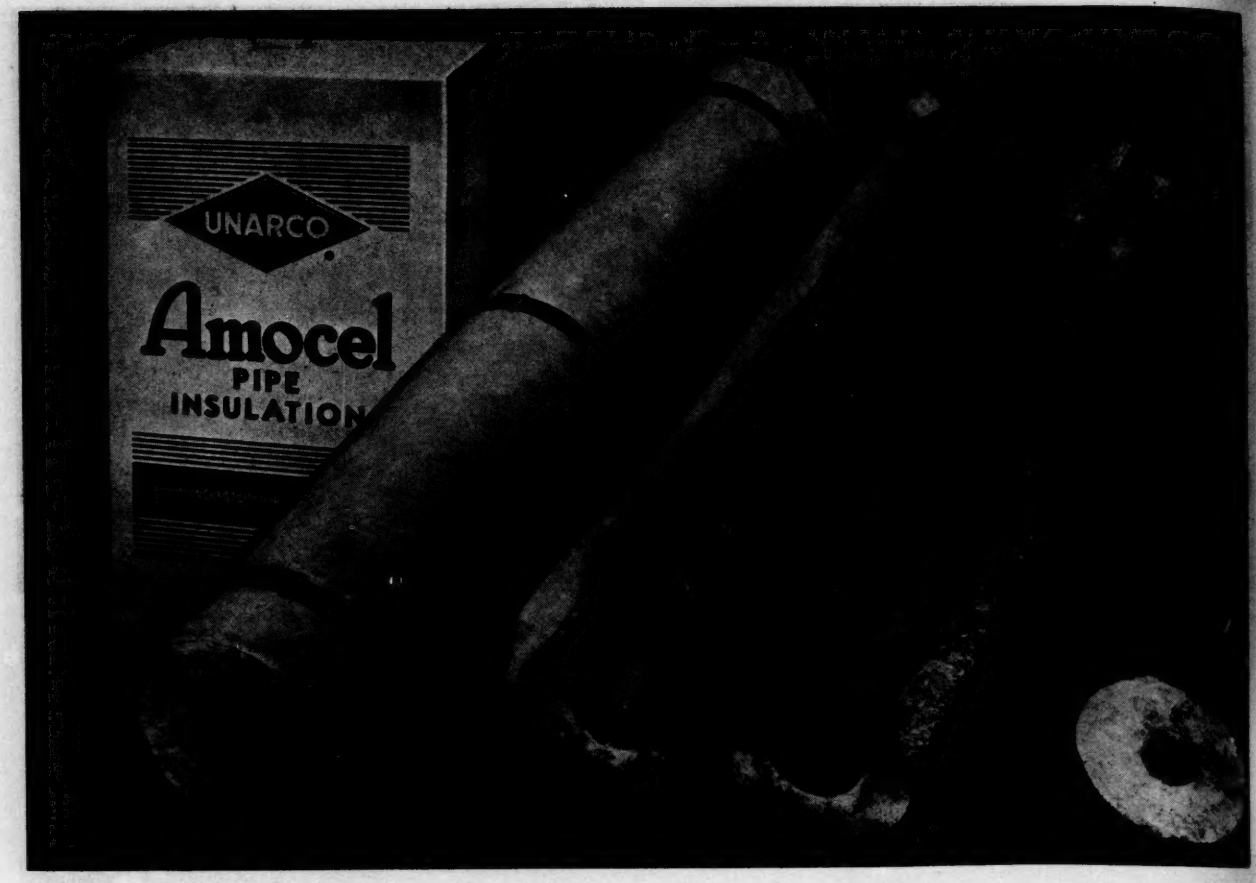

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Amocel for commercial uses—like famous Unarco higher-temperature Unibestos — is made from strong, resilient Amosite asbestos fiber. Designed for temperatures up to 600° F., it's a premium product in every way—clean appearance, long life, high efficiency—and it's easy to fit so you save from the first with this better insulation. Made in standard 1½", and 2" thicknesses for pipe sizes from ½" to 12" in half-rounds with jacket and metal bands. Your Unarco Distributor has Amocel. Call him or write for literature.

- UNHARMED BY MOISTURE, STEAM, OR FUMES
- LIGHT, STRONG—WITHSTANDS IMPACT AND VIBRATION
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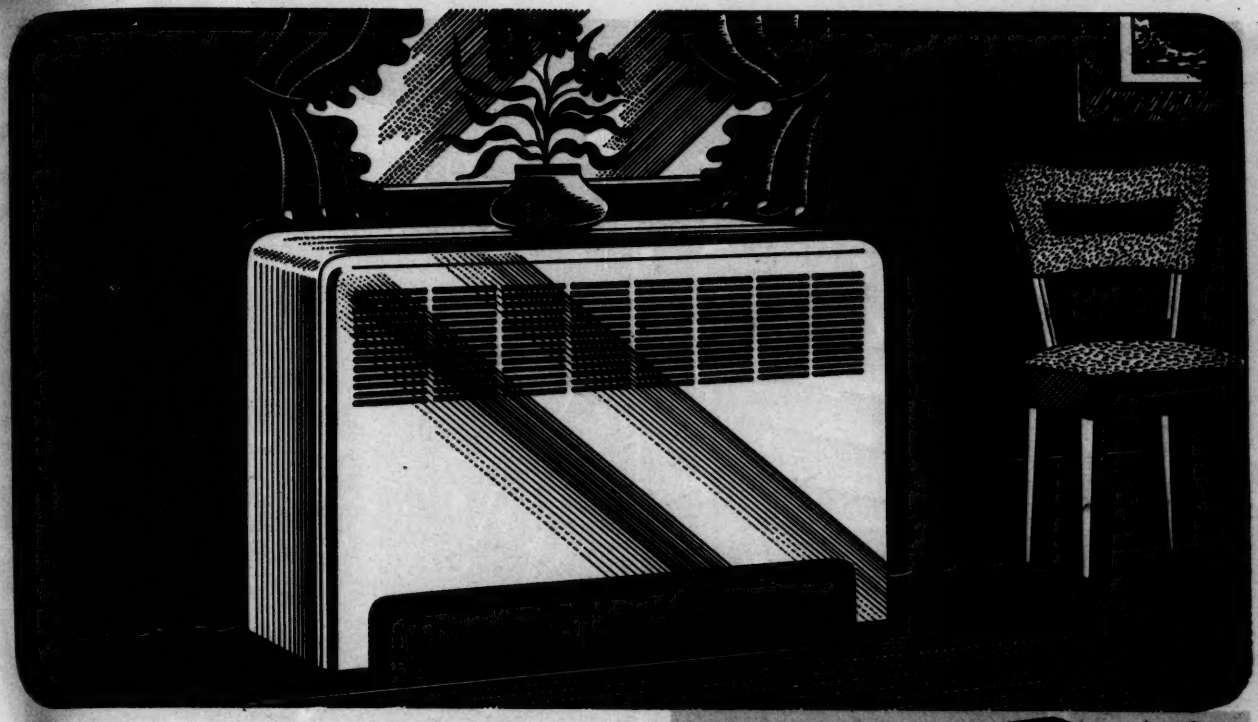
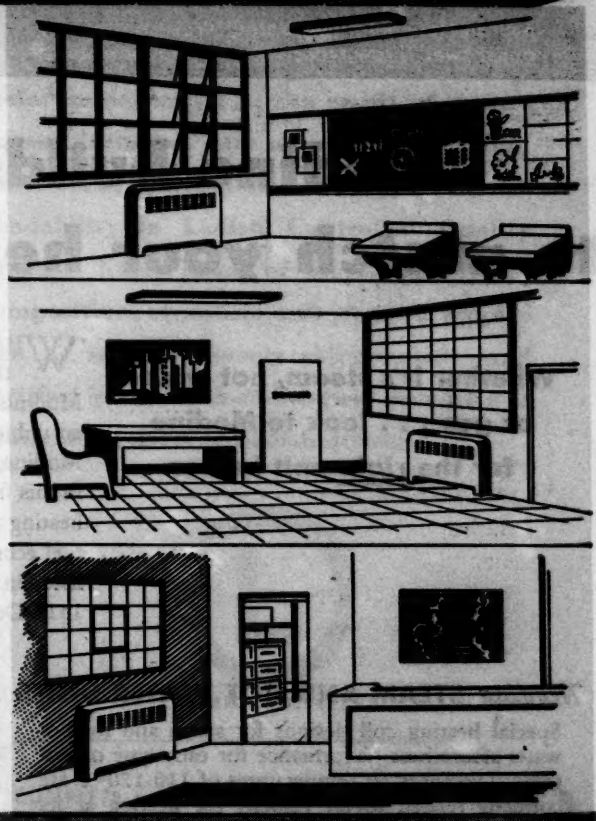
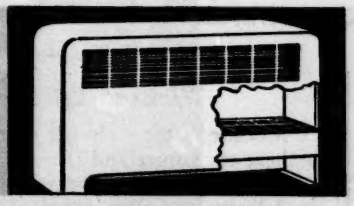


Streamlined Efficiency

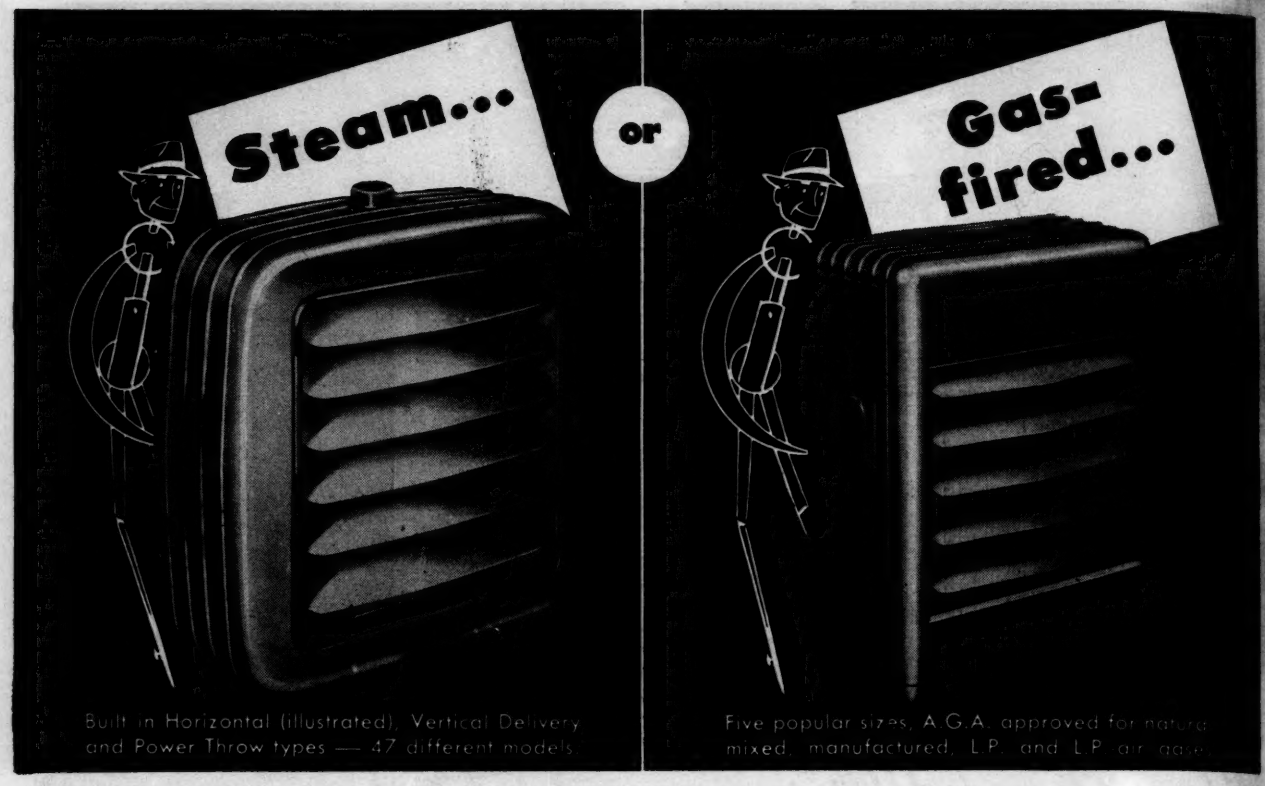
Modern business is of necessity streamlined for utmost efficiency. Thus it is, to satisfy the demands of heating men everywhere, and to keep pace with this trend, that Bush offers their convector radiator. Universal two pipe non-ferrous elements (one pipe available in special element) and heavy gauge steel enclosures suitable for free standing or semi-recess, supply the modern touch to the heating installation. The completely removable front panel simplifies the installation and piping problems. Required pitch is easily obtained by a screw adjustment at either end of the element. Complete units are packed in individual cartons greatly reducing the storage and handling problems. A truly modern, functional unit that demands your attention and commands your respect. Write for Bulletin No. 545 for complete information.



Cutaway view showing element location and case construction.



BUSH CONVECTORS *Ultra Smart*


Steam...
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Gas-fired...
Built in Horizontal (illustrated), Vertical Delivery and Power Throw types — 47 different models
Five popular sizes, A.G.A. approved for natural, mixed, manufactured, L.P. and L.P. air gases

Modine builds a unit heater to match your heating requirements

Whether it's steam, hot water or gas . . . look to Modine for the *right* unit heater

WHATEVER your unit heating requirements, you can match them exactly from the complete Modine line. Because Modine builds steam, hot water *and* gas-fired units, you're sure of an unbiased recommendation. And, remember, when you buy Modine, you buy the greatest name in unit heating. As a leader in this field for more than 25 years, Modine gives you balanced heating performance — perfect heating comfort plus maximum fuel economy. Get all the facts. See the Modine representative listed in your classified phone book, or write Modine Mfg. Co., 1511 DeKoven Ave., Racine, Wis.

Modine STEAM AND HOT WATER UNITS

Special heating coil designs for steam and for hot water assure best performance for each type of system. Discharge air temperatures of 110-120° F are correctly related to air velocity for heating at its best. All-copper coils defy corrosion because fins are bonded to tubes and tubes are brazed to headers. Pre-formed tubes with individual expansion bends absorb stresses, assure long life.

Modine GAS-FIRED UNITS

Modine is the only gas unit with both *stainless steel* heat exchanger and burner. Lighter weight means easier, less expensive installation, plus faster heat delivery — *within five seconds* after thermostat calls for it. Individually fired tubes provide higher heat transfer. Elongated ports — four times free area of conventional drilled ports — minimize clogging and simplify routine cleaning. U-1186

Ask for Bulletin 149-A on steam and hot water and Bulletin 652 on gas unit heaters

Modine UNIT HEATERS

LADISH

Controlled Quality

PIPE FITTINGS

maximum service assured by metallurgical soundness

Sound metallurgy . . . the result of unsurpassed facilities and advanced laboratory controls . . . provides the maximum of dependability in Ladish Controlled Quality fittings. Every phase of metal quality . . . composition, structure and physical properties . . . is continuously safeguarded—and certified proof of metallurgical integrity is available to users of Ladish fittings.

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THE COMPLETE *Controlled Quality* FITTINGS LINE
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Peak Pump Performance

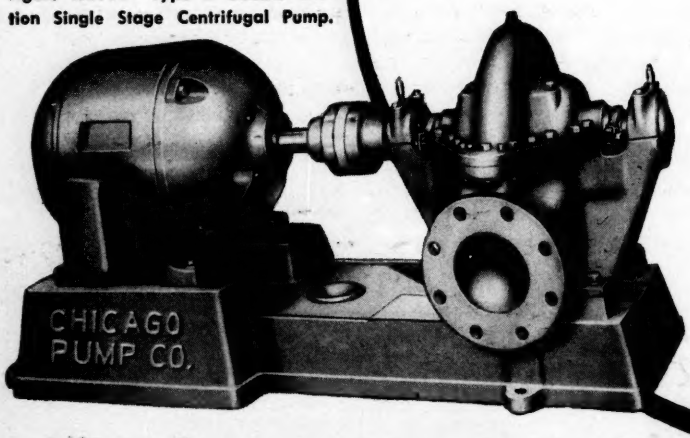
ALWAYS FLOWS FROM CHICAGO TYPE N and TYPE D CENTRIFUGALS

Figure N8927—Type N Close Coupled Pump.

Type N Close Coupled Pump

Compact and sturdy. Designed to handle the toughest pumping jobs efficiently and in the least possible space. A precision built mechanical seal on the shaft requires no adjustment and eliminates dripping. Available in seven frame sizes with capacities up to 500 G.P.M. and heads up to 215 ft. Write for Bulletin 108.

Figure H8111—Type D Double Suction Single Stage Centrifugal Pump.



Type D Double Suction Single Stage Pump

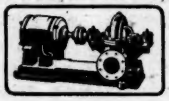
For house pump, fire and booster service this pump combines the best materials available with the skilled craftsmanship found in every Chicago pump. Available in thirteen frame sizes for capacities up to 1900 G.P.M. and heads up to 530 ft. Write for Bulletin 101.

CHICAGO PUMP COMPANY

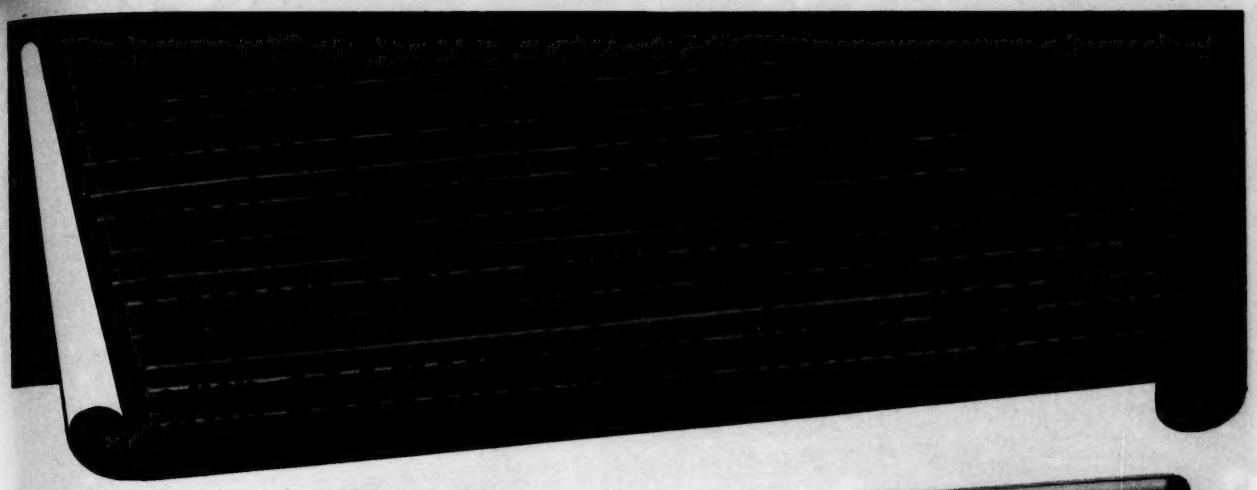
BUILDING and INDUSTRIAL DIVISION

622 DIVERSEY PARKWAY — **CHICAGO 14, ILLINOIS**

Condo-Vac, Sure Return. AVC, LVC, Fire, House & Circulating Pumps Pneumatic & Tankless Water Systems.



Flush-Kleen Sewage Ejectors Little Giant & Non-Clog Bilge Pumps Pumps for every industrial use.

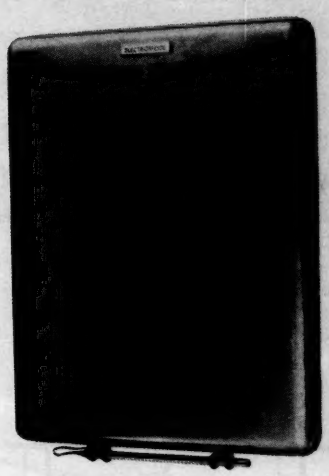


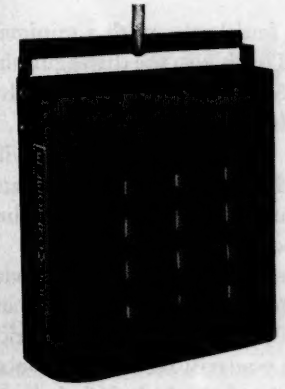
New Design

For HOMES, OFFICES, MOTELS, STORES

Completely redesigned and pre-tested for color, appearance, easy maintenance, convenient controls and heating efficiency, Electromode Automatic Wall Heaters include these user-wanted features. Famous Electromode safety and quality features have been retained . . . cast-aluminum heating element, steel cabinet, factory oil-sealed motor, and power cut-off safety switch. Built-in thermostat permits individual room temperature control. Down-Flo principle circulates heat at floor level. Easy to install in new building or remodeling.

Automatic Down-Flo Model WA 1500 to 4000 watts



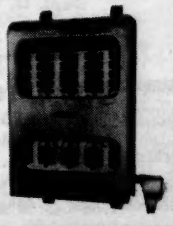


For PLANT, OFFICE, WAREHOUSE

For any plant or office heating problem, any hard-to-heat area, choose Electromode Unit Space Heaters. These all electric heaters are available in all sizes and capacities from 1500 to 45,000 watts to fit any heating problem. They can be located anywhere that electric wiring can be strung. Equipped with automatic temperature controls and built-in safety switch, means economy of operation and absolute safety from fire, shock or burn. The exclusive patented cast-aluminum heating elements will not rust or corrode. Electromodes provide an abundance of fan-circulated heat when and where it is needed. Approved by Underwriters' Laboratories and thousands of commercial and industrial plants throughout the country.

For HAZARDOUS AREAS EXPLOSION-PROOF HEATERS

The only Electric Explosion-Proof Heater of its kind approved by Underwriters' Laboratories. Features Electromode patented cast-aluminum heating element. Specially designed for installation in hazardous areas where heat is required and danger of explosion exists. Available in 2000, 4000, 6000 watt capacities.



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. . . on Domestic, Commercial and Industrial Electric Heating, full of specifications, illustrations, installations, diagrams, and how to figure electric space heating. Send NOW—All New.

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ELECTROMODE
All-Electric HEATERS

Permanent Valves and Traps for a Permanent Building . . .

Federal Office Building
NASHVILLE, TENNESSEE

Architects — Engineers:
Marr & Holman, Nashville

Plumbing and Air Conditioning Contractors:
J. M. Gallagher Company, Nashville

Impressive even in the vast building program of the Public Buildings Administration is this big Federal Office Building at Nashville, Tenn.

Buildings like this are built to function faultlessly, with a minimum maintenance, for a long, long time to come. This is also the distinguishing characteristic of Marsh Heating Specialties. So the choice of Marsh Valves and Traps for this massive structure is entirely logical.

At the right of the illustration you see a part of the stately Nashville Post Office. Erected in the late thirties and also equipped with Marsh Heating Specialties, it stands as another example of a permanent building provided with permanent heating equipment.

Indeed this respect for Marsh quality is demonstrated on a nation-wide scale in the selection and specification of Marsh valves, traps, vents and controls for finer buildings, large and small, in every part of America. Use Marsh equipment on your next job and you will see in its advanced design and trouble-free service why it is the first choice of the most discriminating heating men.

In the Marsh metal-to-metal seal you have the finest packless valve construction and in the Marsh radiator trap you have the most efficient team-mate for it. This combination was widely used in the Nashville Federal Office Building.

This Marsh float and thermostatic trap is typical of a wide line of Marsh traps for all services. Many are installed at Nashville.

MARSH HEATING EQUIPMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*
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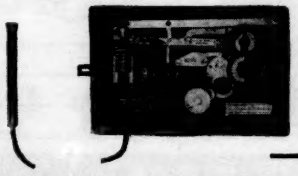

BIG FUEL SAVINGS — WITH HEAT REGULATION IN STEP WITH THE WEATHER.
Maximum comfort with minimum heating costs . . . that is what the Marsh-Tritrol accomplishes by controlling heat in step with outside weather. Ask for facts.

MARSH *Heating Specialties* SINCE 1865

Yours for the asking—

A VOLUME OF DATA

. . . covering welding fittings and forged steel flanges . . .

ON A SINGLE SHEET

Here is just about the handiest tool ever devised for the pipe designer. Data on welding fittings and flanges that otherwise could be found only by plowing through many catalog pages and tables have been ingeniously condensed on the two sides of the durable letter-size card illustrated above.

One side covers the broad WeldELL line of Taylor Forge welding fittings. For every nominal pipe size, ½" through 30", it shows the wall thickness for every weight of every fitting in every available material. It also shows all required dimensions of all types of fittings.

The other side covers the world's most complete line of forged steel flanges. For every nominal pipe size, ½" through 24", it gives all essential dimensional and bolting data for all types of flanges in all weights. A particularly useful table (see reproduction) is that showing welding neck flange bores which enables you to determine the I.D. of any nominal pipe size without separate calculation. Thus the sheet gives you O.D. and I.D. of any weight of pipe.

The card is varnished to make it stand the steady usage you are certain to give it. To obtain your copy see your Taylor Forge distributor or **MAIL THE COUPON.**

TF

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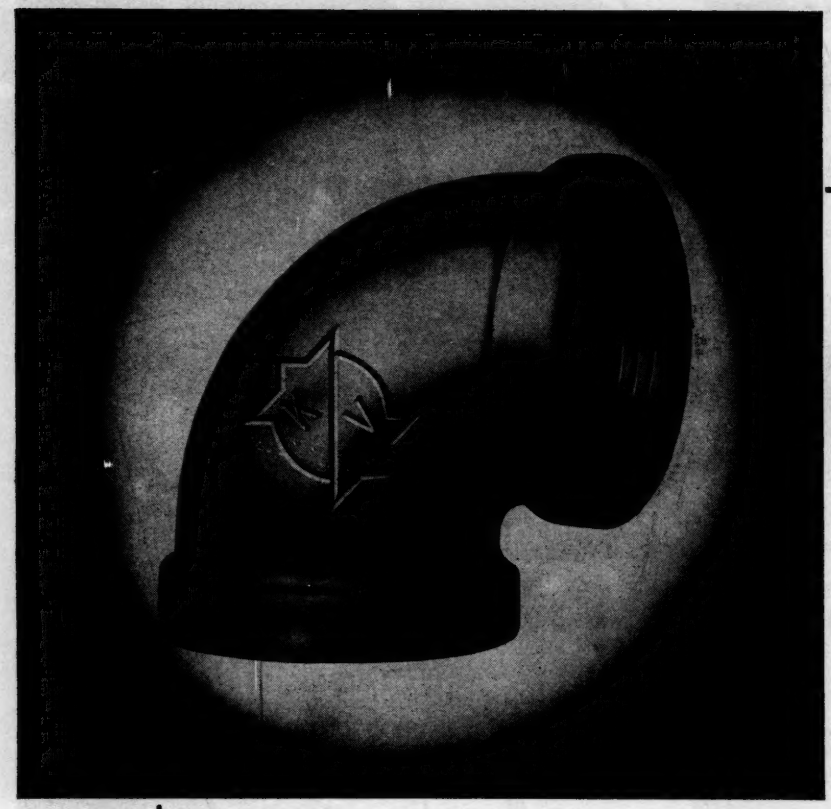
COMPANY_____

STREET ADDRESS_____

CITY_____ ZONE____ STATE_____

511-1152 Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.



RIGID KENNEDY INSPECTION

Guarantees Fittings Free of Leaks, Burrs and Scales

KENNEDY MALLEABLE-IRON screwed fittings are made with tough, close-grained iron, tested to 43,000 psi. Carefully controlled annealing prevents splitting or cracking under almost any distortion forces. Uniform hot-dip galvanizing assures a heavy coating that will not chip or flake. Precision machining provides exact alignment . . . speeds installation time.

KENNEDY CAST-IRON screwed and flanged fittings are made with tough, close-grained metal *more than* 50% *stronger* than ordinary gray iron. Precision threading and accurately machined flanges help you get strong, tight joints easily. The complete Kennedy line also includes cast-iron sprinkler and drainage fittings, cast-iron flanges.

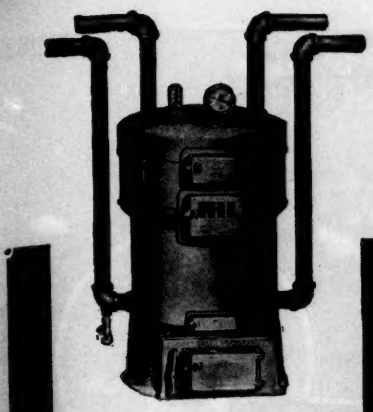
KENNEDY BRONZE fittings with tensile strength of 34,000 psi are individually tested to 100 lbs. air pressure under water to insure freedom from leaks. Available rough or polished in all standard types and sizes.

WRITE FOR BULLETIN 104

KENNEDY INSPECTED FITTINGS

THE KENNEDY VALVE MFG. CO.
ELMIRA, NEW YORK

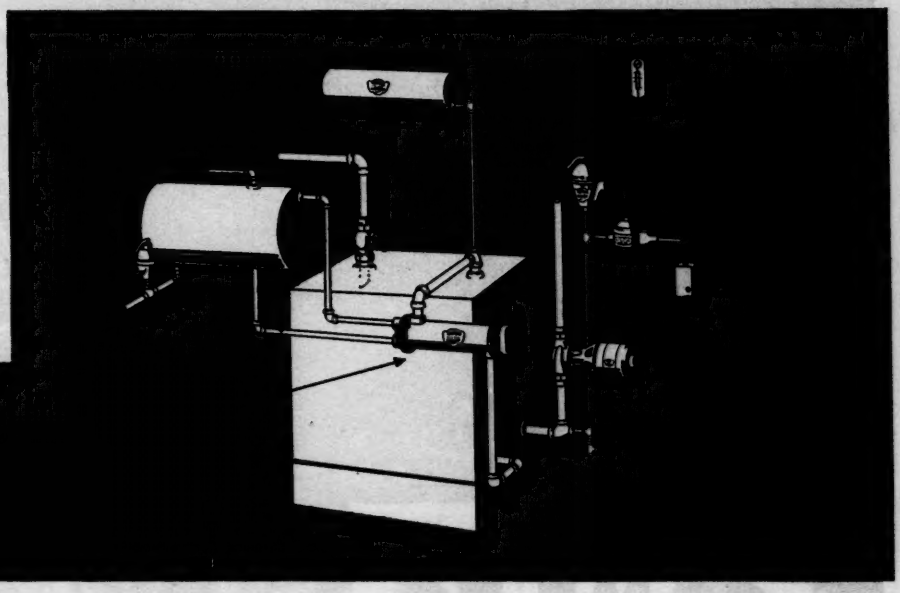
VALVES · PIPE FITTINGS · FIRE HYDRANTS



There are many old installations like this in every community just waiting for you! Go after them with a Thrush modernization plan.

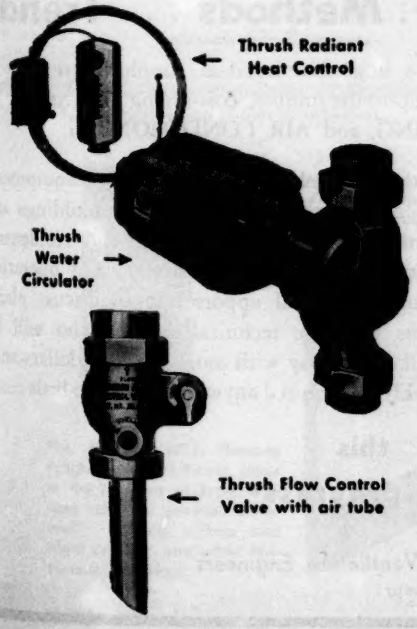
Modernize old heating plants now . . . with Thrush Equipment

Any hot water heating system can be converted easily into a modern, forced circulating heating plant with a few inexpensive Thrush units.



THRUSH . . .

Flow Control System of Radiant Hot Water Heat!



THRUSH Flow Control System installed on old hot water heating plants gives controlled comfort in every room in the house. Many homeowners would modernize if they knew it was possible to convert to a modern system at such moderate cost. A Thrush Water Circulator with Thrush Flow Control Valve will provide positive circulation without overheating. Thrush Water Heater will assure a plentiful supply of domestic hot water from the same boiler in summer and the whole year through. If you are not now installing Thrush equipment, see your wholesaler or write Department D-11.

H. A. THRUSH & COMPANY

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SEE NEW Ideas . . . Products . . . Methods . . . Trends

in HEATING VENTILATING AIR CONDITIONING

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JAN. 26–30

For 5 full days, Chicago's huge International Amphitheatre will be bulging with ideas and up-to-the-minute, cost-saving information on HEATING, VENTILATING, and AIR CONDITIONING.

More than 300 exhibits will display the latest methods, equipment, and parts developed for conditioning air in all types of buildings and plants—public, institutional, commercial, industrial, and residential. Architects, contractors, distributors; consulting, design, and operating engineers, all will have an exceptional opportunity to discuss plans, problems and requirements with the technical experts who will be staffing the exhibits . . . will come away with more practical dollars-and-cents ideas than could possibly be acquired anywhere else in so little time.

ATTEND and BENEFIT from this
5-day exposition of ideas and progress

Auspices of the American Society of Heating and Ventilation Engineers
Management International Exposition Company

For *Steam* Heating, too, it's **Sarcotherm**!

Effective control of steam heating systems for single or multiple buildings is best accomplished by continuously modulated flow of steam, proportioned automatically by outdoor temperature.

The carefully engineered SARCOSTAT SYSTEM shown diagramatically in Fig. 1 fulfills these requirements perfectly. Many are now in successful operation.

The heart of the system is the Sarcostat hydraulic-electric control valve (Fig. 1) installed in the main steam supply line to each zone and positioned by the combined effect of the outdoor temperature and the influence of steam pressure existing on the downstream side of the valve.

Successful operation is predicated on careful sizing of orifice plates in each radiator or convector, which is part of the engineering service provided by Sarcotherm.

If you are seeking trouble-free heating control of steam systems of any size or type, we shall be glad to place our experience at your disposal without obligation.

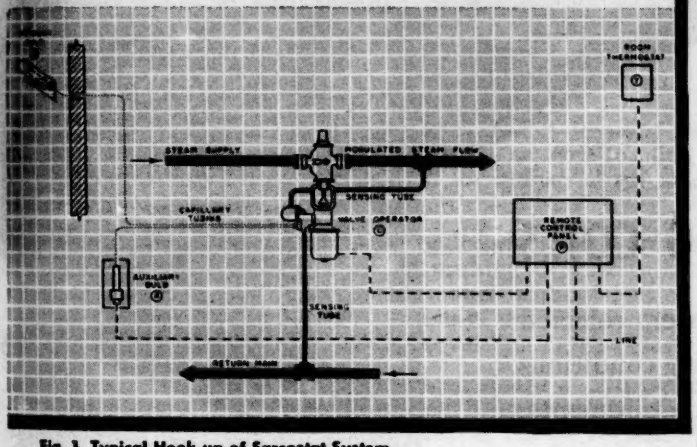


Fig. 1, Typical Hook-up of Sarcostat System.

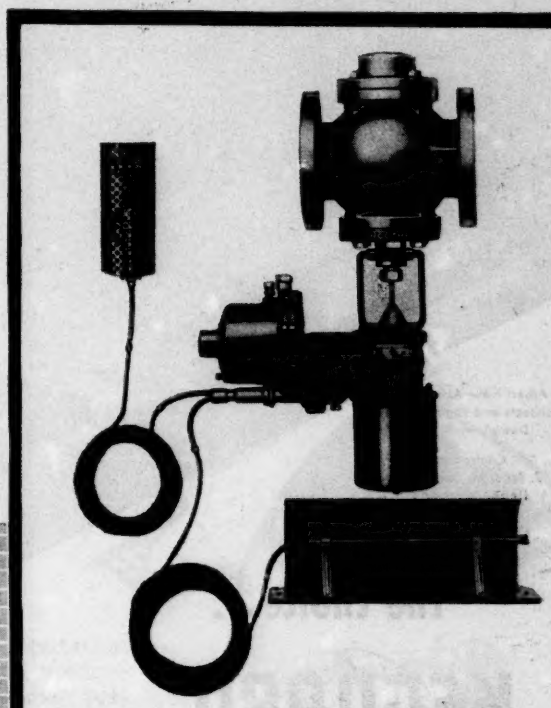


Fig. 2, Sarcostat Modulating Control Valve, Type W-1.

Fig. 3, Type W Manual remote Control Panel is equipped with temperature adjusting knob for "warmer" and "cooler," also a four-position Selector Switch for "Automatic," "Full Heat," "Heat Off," and "Summer."

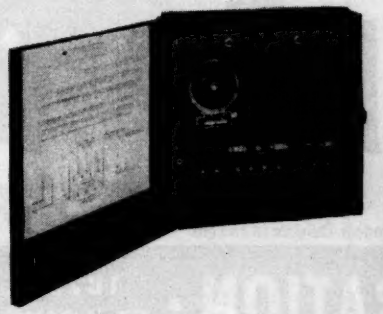
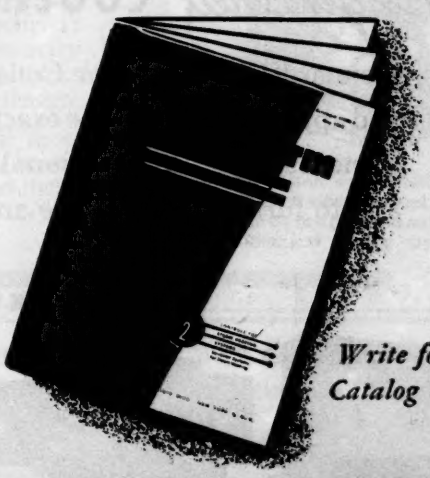


Fig. 4, Type WSA Remote Program Control Panel, adds to the features of type W a time clock to provide automatic morning pickup and night setback, and other features as specified.



Write for NEW Catalog ST500-2

25

SARCOTHERM CONTROLS, INC.

A SARCO PRODUCT

NEW SINAI HOSPITAL

DETROIT, MICHIGAN

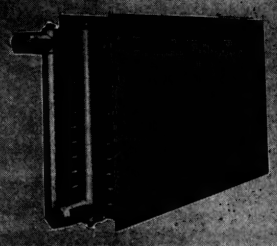
Albert Kahn Associated Architects and Engineers, Inc., Detroit, Michigan

Contractor: J. Brodie & Sons, Inc., Detroit, Michigan

The choice...

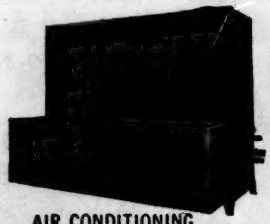
KENNARD *Engineered* COOLING COILS

Kennard Chilled Water Coils were selected and approved to meet the exacting conditions so necessary to professional requirements, and to further patient care and comfort.



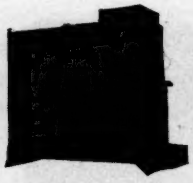
Typical Chilled Water Coil installed in Sinai Hospital

OTHER KENNARD PRODUCTS



AIR CONDITIONING BLOWER UNITS
Horizontal or Vertical

HEATING AND VENTILATING UNITS



EVAPORATIVE CONDENSERS
Indoor-Outdoor to 75 Tons

MULTI-ZONE UNITS

COOLING TOWERS
Up to 75 Tons

KENNARD CORPORATION • 1823 S. HANLEY ROAD ST. LOUIS 17, MO., U.S.A.

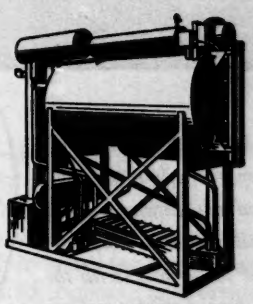
He specified Servel...

the dependable air conditioning equipment

He can rest assured because Servel has a well-deserved reputation for reliability and economy in meeting all air conditioning needs—comfort air conditioning, chilled water for industrial processing, precooling air for industrial applications.

Reliability—Because Servel Air Conditioning has *no moving parts* in the refrigeration system, there is nothing to vibrate or wear. It operates continuously at peak performance without loss of capacity and with minimum maintenance. A five-year factory warranty backs up the dependability of the famous Servel "no moving parts" design.

Economy—The Servel unit operates on steam at atmospheric pressure which can be obtained from any source—waste steam, waste heat or district steam. With simple controls, the Servel unit modulates to meet varying load conditions. Capacity can be reduced to as low as 50% with corresponding savings in steam consumption.



The Servel 25-ton water chiller has low floor loading, no vibration and quiet operation. It can be installed on any floor with most economical piping arrangement.

Investigate the proved advantages of Servel . . . There's a Servel unit or combination that will provide the best *in air conditioning at the lowest operating and upkeep cost. Mail the coupon* today *for full information.*

Servel

the name to watch for great advances in

AIR CONDITIONING ✓ REFRIGERATION

SERVEL, INC., DEPT. HV11, Evansville 20, Indiana

Send me further information about Servel Air Conditioning equipment for:

☐ Comfort air conditioning ☐ Industrial applications

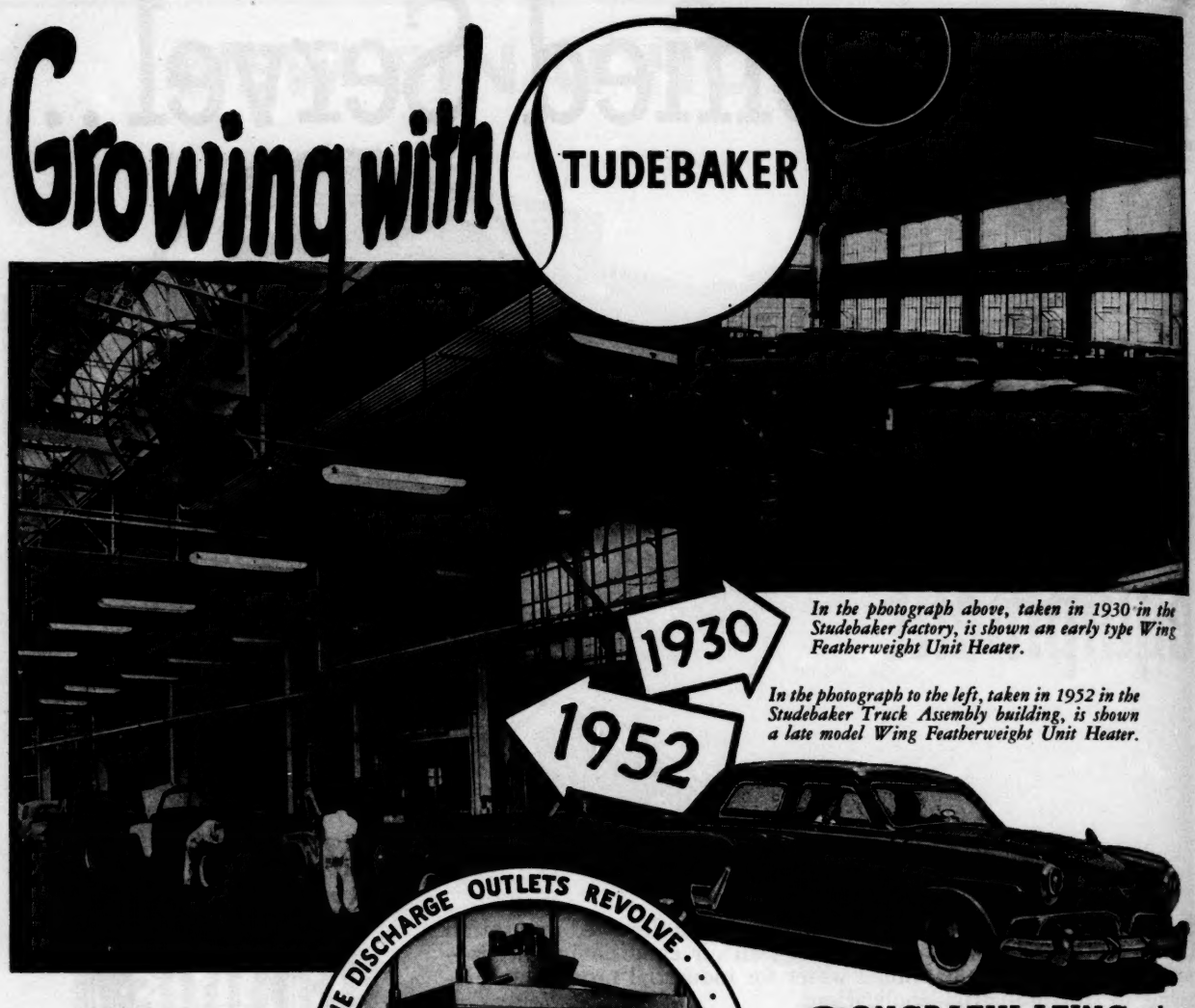
Name_____

Firm_____

Address_____

City_____ Zone____ State_____

Growing with STUDEBAKER



In the photograph above, taken in 1930 in the Studebaker factory, is shown an early type Wing Featherweight Unit Heater.

In the photograph to the left, taken in 1952 in the Studebaker Truck Assembly building, is shown a late model Wing Featherweight Unit Heater.

The Wing Revolving Unit Heater, not only is the ideal method of heating a plant or building, but may also be used in summer (with the steam turned off) for cooling.

CONGRATULATING the Studebaker Corporation on its hundredth anniversary reminds us that L. J. Wing Mfg. Co. has been supplying Studebaker with heating equipment for over a quarter of a century. Since 1926, over 445 Wing Unit Heaters and Heater Sections have been installed in Studebaker plants. And, as Studebaker has pioneered in many notable automotive improvements, so Wing has led the way in many improvements in heating equipment.

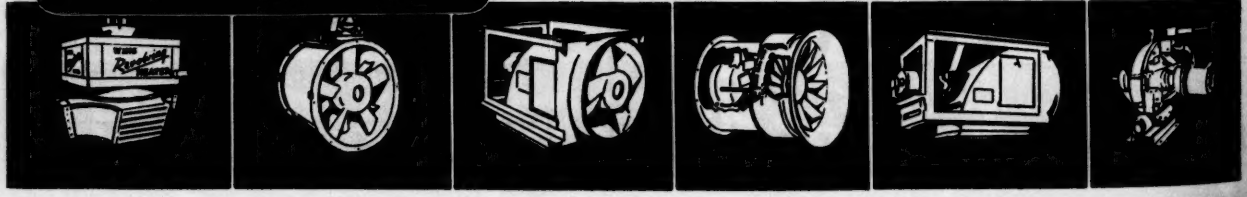
Wing

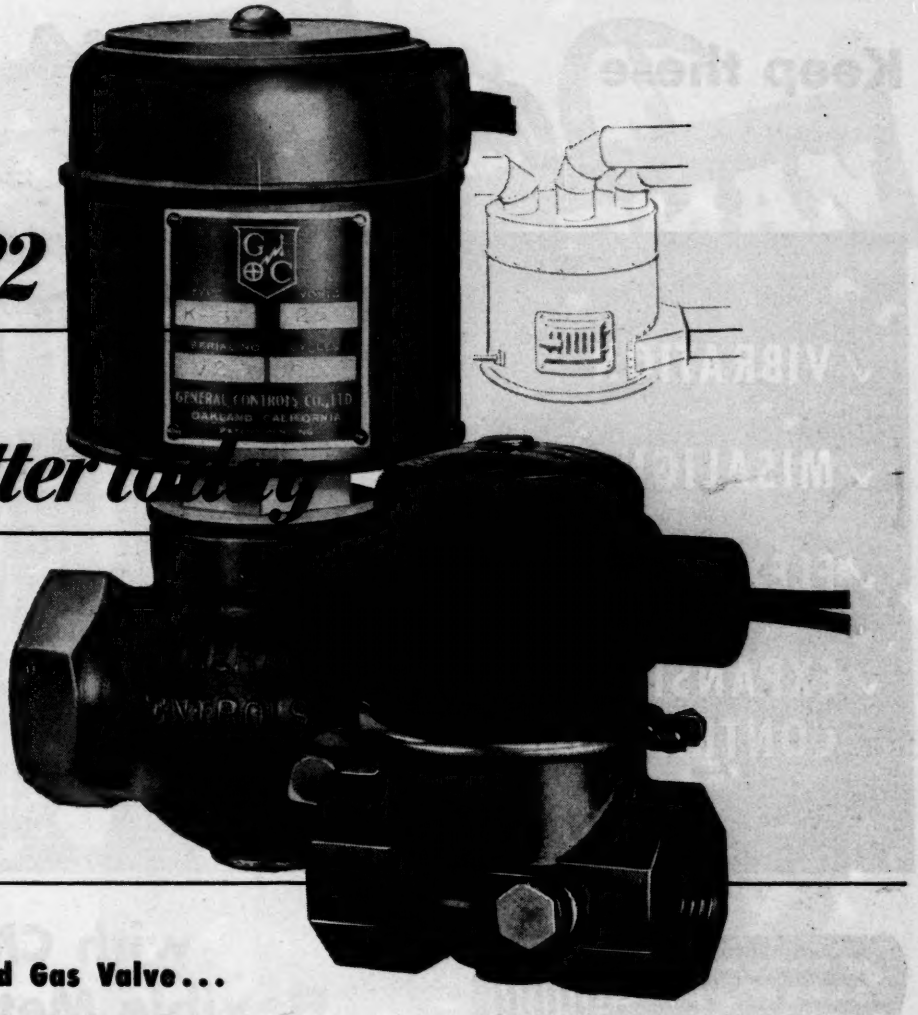
REVOLVING UNIT HEATERS

L. J. Wing Mfg. Co. 158 Vreeland Mills Road, Linden, N. J.

Factories: Linden, N. J. and Montreal, Canada

In Europe: Etab. WANSON, Haren-Nord, Brussels, Belgium





new in '32

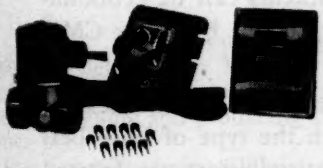
still better today

Improved K3-A Solenoid Gas Valve...

Quiet—Dependable—Hi-Capacity—

Soft Seat—For All Gases—

Way back in 1932, the forebear of the present K3-A was originated, developed and pioneered by General Controls. It became the first in a long series of quiet, dependable, two-wire solenoid magnetic gas valves that today are standard equipment at home and in industry for controlling gas to warm air furnaces, gas-fired boilers, conversion burners and similar applications. Closing with the gas flow, in the K3-A the pressure is on the top of the soft seat assuring indefinitely tight valve shut-off. Closing is automatic in case of power failure, and the K3-A, like all other General Controls solenoids, is absolutely humless when energized. Current consumption is low and the extremely compact valve easily meets high flow capacities and operating pressure requirements. In the K3-A you find just one more sound reason why the leaders everywhere declare that for the best in *automatic* controls, it's General Controls!



T-30 PACKAGE SET

For automatic heat at home, the General Controls T-30 Package Set is a sure short cut to economical and trouble-free comfort. Included with the graceful T-70 Timer Thermostat, is the long-proved, Type K3 Magnetic Gas Valve, Transformer and Thermostat Cable. Optional Timer Thermostat is furnished in two models, either for internal night setting (T-70-T) or with both day and night temperature selection at your finger tip (T-70-X) on the face of the sleek and satin-finished cover.

GENERAL CONTROLS

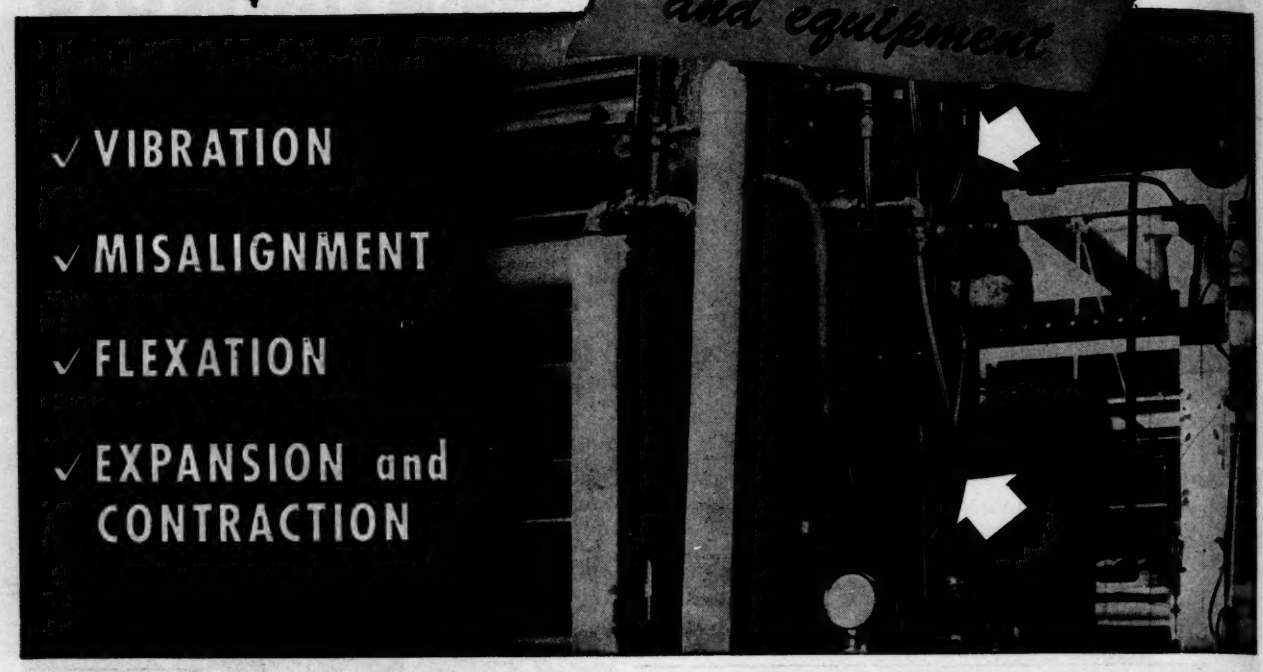
801 ALLEN AVENUE GLENDALE 1, CALIFORNIA

Manufacturers of Automatic Pressure, Temperature, Level and Flow Controls

FACTORY BRANCHES: Baltimore 5, Birmingham 3, Boston 16, Buffalo 3, Chicago 5, Cleveland 15, Columbus 15, Dallas 2, Denver 4, Detroit 21, El Paso, Glendale 1, Houston 6, Indianapolis 4, Kansas City 2, Milwaukee 3, Minneapolis 2, Newark 6, New Orleans, New York 17, Omaha 2, Philadelphia 23, Pittsburgh 22, St. Louis 3, San Francisco 7, Seattle 1, Tulsa 6, Washington 6, D.C.

DISTRIBUTORS IN PRINCIPAL CITIES

Keep these *Dangerous* stresses *out of piping and equipment*



CMH Corrugated Flexible Metal Hose can be furnished in steel, bronze, stainless steel and other alloys. Depending on size, type and material, pressures up to 12,000 psi (burst) and temperatures up to 1600° F. can be handled.

CMH Convoluted Metal Hose is made in a variety of types and in steel, bronze and alloys. Depending on size, type and material, pressures up to 500 psi and temperatures up to 600° F. can be handled.

with CMH Flexible Metal Hose

MOTION or misalignment in rigid piping presents serious problems to the plant engineer. Piping subject to these stresses is in a potentially dangerous condition. In most cases these problems can be economically, dependably and safely solved by using CMH Flexible Metal Hose.

As a manufacturer of a complete line of flexible metal hose, CMH can furnish the type of hose best suited to your needs. CMH distributors are located in principal cities. See your classified telephone directory or write for his name. If you would like to have literature describing the CMH line, write for it, mentioning the types of connection problems you have.

Flexon identifies CMH products that have served industry for over 50 years.

CHICAGO METAL HOSE Division

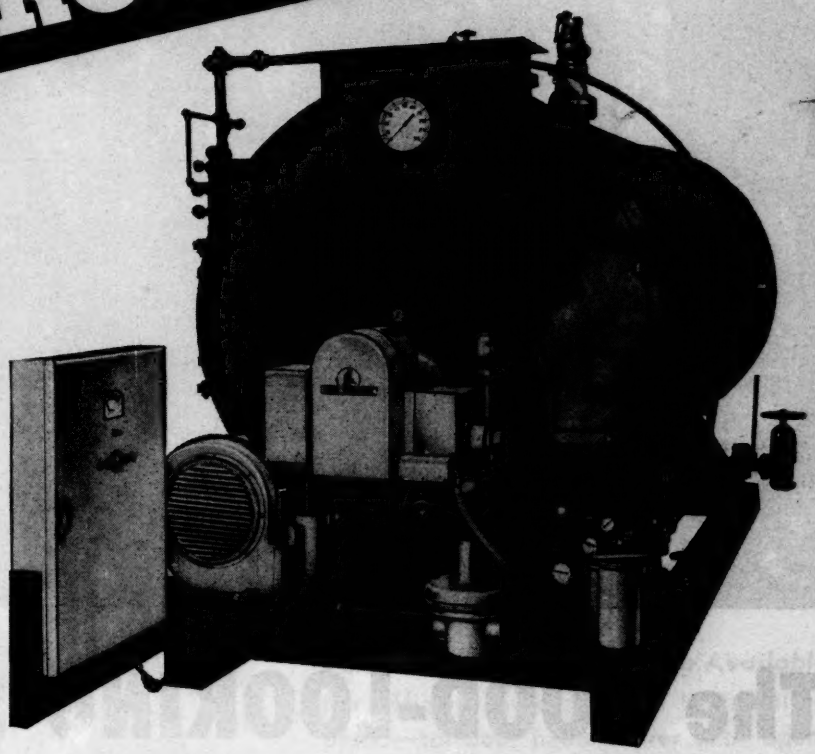
Flexonics Corporation

1360 S. Third Avenue • Maywood, Illinois

Manufacturers of Convoluted and Corrugated Flexible Metal Hose in a Variety of Metals • Expansion Joints for Piping Systems • Stainless Steel and Brass Bellows • Flexible Metal Conduit and Armor • Assemblies of These Components
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

KEWANEE and IRON FIREMAN

- *For oil, for gas, or oil and gas firing*
- *For every commercial and industrial application*



Jointly announce a NEW boiler-burner UNIT

Two outstanding companies in their respective fields—Iron Fireman and Kewanee—have combined their engineering talents and their long experience in designing and producing this unique new boiler-burner unit.

Every part has been skillfully engineered for balanced operation to give users what they want; efficient utilization of fuels, with resulting low-cost steam; and fully automatic, dependable performance.

The burner, including all controls, built-in forced draft fan and oil pre-heating system, is completely assembled, wired, tested and shipped to the installation site from Iron Fireman. The boiler, completely assembled with all of its essential elements, is shipped from Kewanee. Matching connections are provided for quick, easy installation.

Available for high pressure steam in sizes with outputs ranging from 52 to 456 h.p., 125 and 150 lb. working pressure, and also from 5470 EDR 15 lb. steam or 30 lb. water. These units may be automatically fired with No. 6 or lighter fuel oils, gas (either high pressure or as low as 2 oz.) or a combination of both fuels.

Send for this 14-page catalog

This catalog, produced in full color, gives COMPLETE information on all sizes and models, including *detailed specifications.*

Use coupon or write

MAIL to KEWANEE or IRON FIREMAN

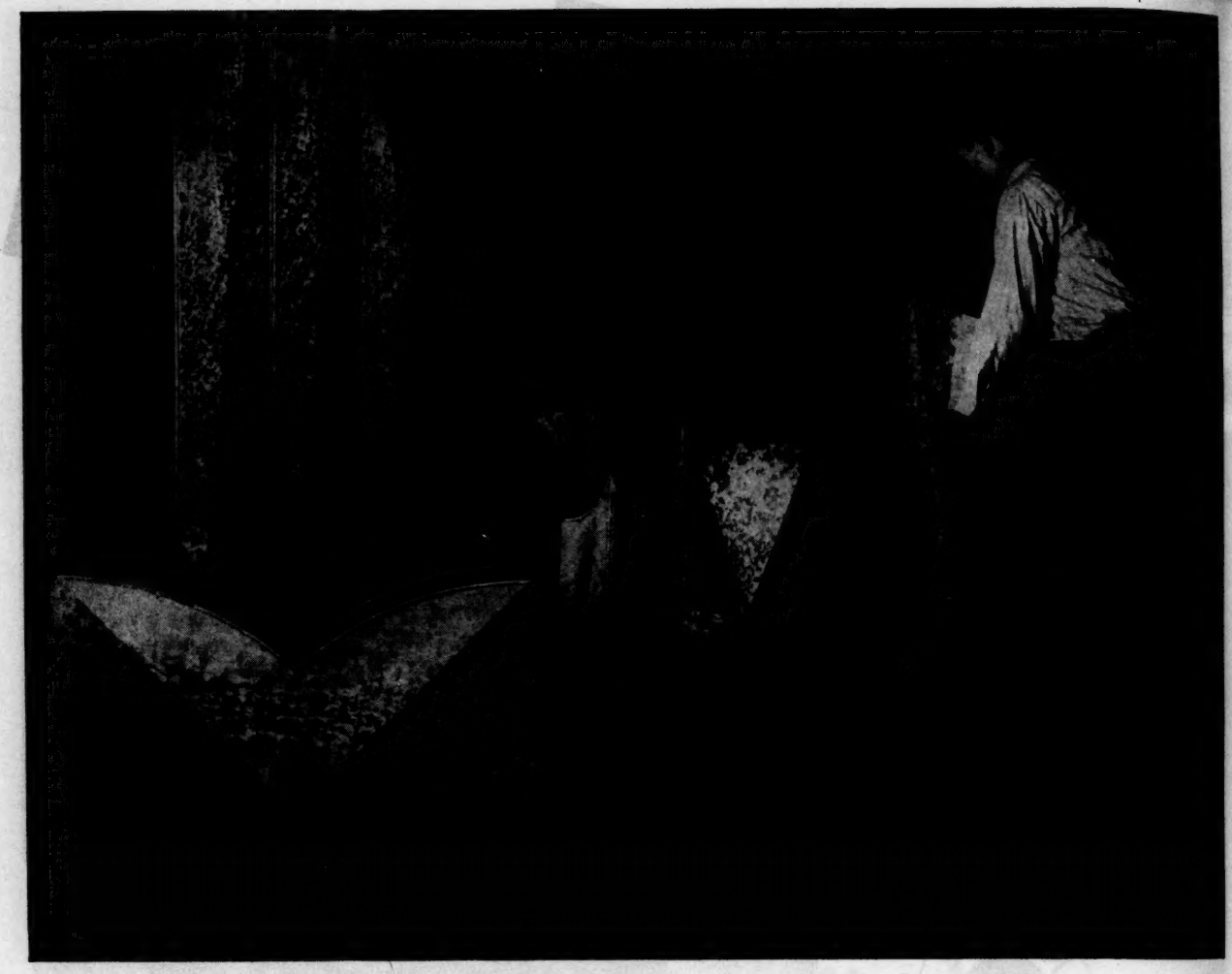
Name_____

Company_____

Address_____

IRON FIREMAN MFG. CO.
3113 West 106 Street, Cleveland 11, Ohio

KEWANEE-ROSS CORPORATION
119 Franklin Street, Kewanee, Illinois



The GOOD-LOOKING SHEET

is Galvanized Steel

Appearance packs a punch when it comes to selling a sheet-metal job. Your customer has had experience with many different galvanized-steel products and he knows that things made of this material will keep their good looks.

Bethlehem Galvanized Sheets are uniformly coated with Prime Western zinc to protect them against corrosion and to give them the bright, sparkling appearance that customers like. Beneath this coating is a base of strong, durable steel, either plain or copper-bearing.

Besides their good appearance, Bethlehem Galvanized Sheets are easy to handle and to work. They can be handled without denting or kinking; they can be cut, formed and soldered without difficulty. They help you turn out better jobs, in shorter time at higher profits.

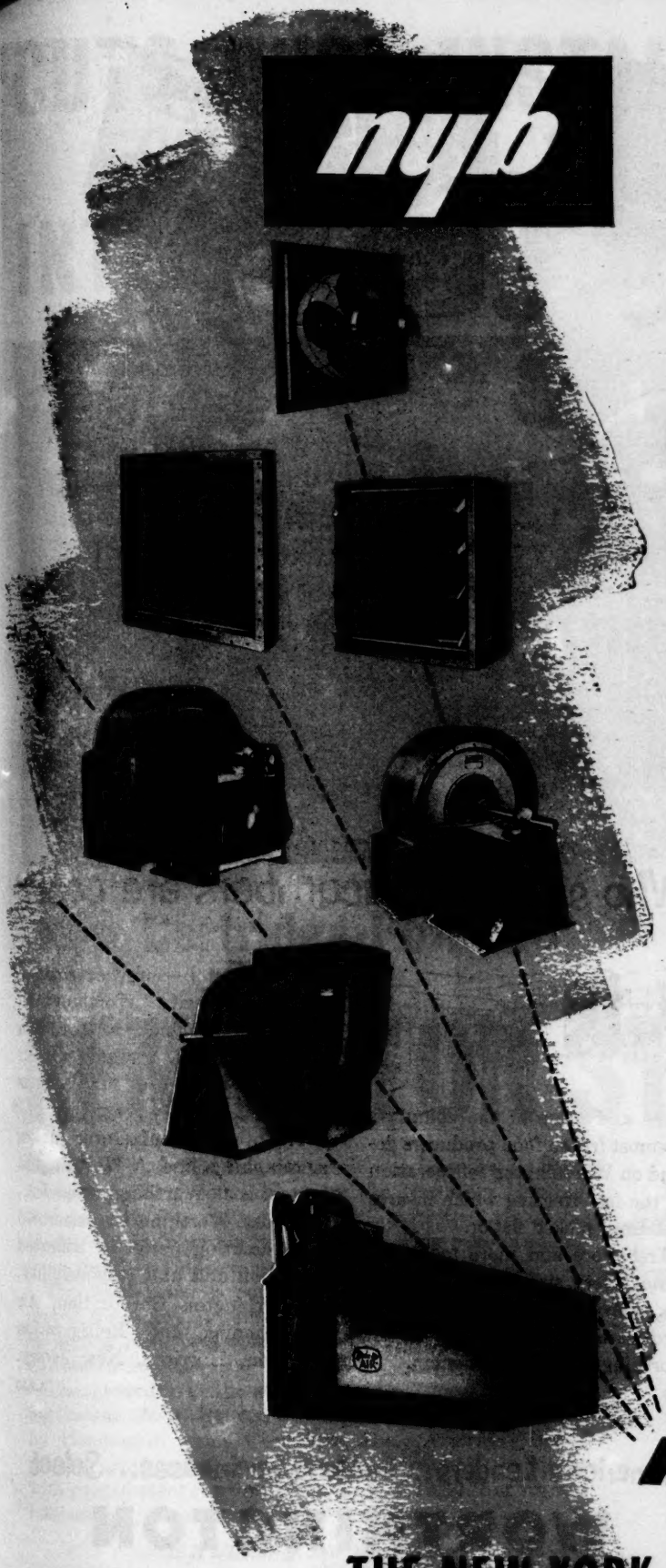
Bethlehem
GALVANIZED
Steel Sheets

★ BETHLEHEM STEEL ★

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

Export Distributor: **Bethlehem Steel Export Corporation**



nyb

Investigate

COMET

Unit Heaters

BUILT TO MEET MODERN INDUSTRIAL REQUIREMENTS

For Continuous Heat Service up to 150 Pounds Steam Pressure

Horizontal Type

Ceiling suspension type with heavy duty welded steel fin-and-tube heating element. The rugged arc-welded construction outperforms and outlasts heating elements made of thinner non-ferrous metals. Avoids their expansion-contraction faults, yet has the same BTU efficiency. Ten basic sizes with capacities from 30 Mbh to 490 Mbh. Totally enclosed motors. (Extra heavy non-ferrous coils also available.)

Vertical Projection Type Also Available

For efficient heating from high-ceiling areas—for door heaters over small openings—or where the horizontal type Comet Heater is not applicable. Ten basic sizes; capacities from 27 to 332 Mbh.

Write for Bulletins

No. 513 Horizontal Type
No. 484 Vertical Type

FANS • BLOWERS • UNIT HEATERS • MAKE-UP AIR UNITS • HEAVY DUTY HEAT SURFACE

nyb

SEE OUR CATALOG IN SWEET'S

THE NEW YORK BLOWER COMPANY

SALES OFFICES • 32nd STREET and SHIELDS AVENUE • CHICAGO 16

FACTORY, LAPORTE, INDIANA

Who said only cucumbers are cool?

More and more of the country's foremost frozen food producers depend on Worthington refrigeration for the fast freezing which insures that fresh-picked flavor.

And more and more food outlets of every size protect produce . . . keep customers contented regardless of the weather . . . with Worthington air conditioning.

For any job—large or small—when you specify "Worthington" for air conditioning or refrigeration you specify the equipment your client links with the "first" names in every field.

No other manufacturer makes *so complete* a line. A Worthington system is all Worthington-*made*... not just Worthington-assembled . . . assuring perfectly balanced operation and unit responsibility.

Worthington Corporation, Air Conditioning and Refrigeration Division, Harrison, New Jersey.

A-2.10

America's Leaders... in Many Businesses... Select

WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

CUTS DUCT INSTALLATION TIME 50% IN AIR CONDITIONING INTERNATIONAL AMPHITHEATRE

Courtesy: Narowetz Heating & Ventilating Company, Chicago, Ill.

Listed and approved by Underwriters' Laboratories

New Cartridge-Powered MODEL 450

REMINGTON STUD DRIVER

Despite a close deadline, ductwork was installed in time for both political conventions by the Narowetz Heating & Ventilating Company of Chicago... with the help of the Model 450 Remington Stud Driver. This revolutionary tool's speed and efficiency saved time and cut costs.

The Model 450 is completely self-powered and engineered for safety . . . sets as high as 5 studs per minute in joining steel and wood structural pieces to concrete and steel surfaces.

Test-proved to be the world's finest and speediest fastening system, the Model 450 Remington Stud Driver is made by Remington Arms Company, Inc., *America's oldest sporting arms manufacturer*. Price for Model 450, complete with rugged steel carrying case—only $119.50. For further information, fill out and mail the coupon.

"If It's Remington—It's Right!"

Remington DUPONT

It's fast, easy and safe to operate the Remington Stud Driver

Simply hand-assemble stud and power cartridge, load as a unit in easy-to-open Remington Stud Driver and close.

Then press loaded Stud Driver firmly against work surface, depress safety lever, and pull trigger. Explosive charge imbeds stud solidly.

Remington Arms Company, Inc.
Industrial Sales Division, Dept. HV-11
939 Barnum Ave., Bridgeport 2, Connecticut

I am interested in obtaining detailed information on the Model 450 Remington Stud Driver.

*Name*_____

*Firm*_____

*Position*_____

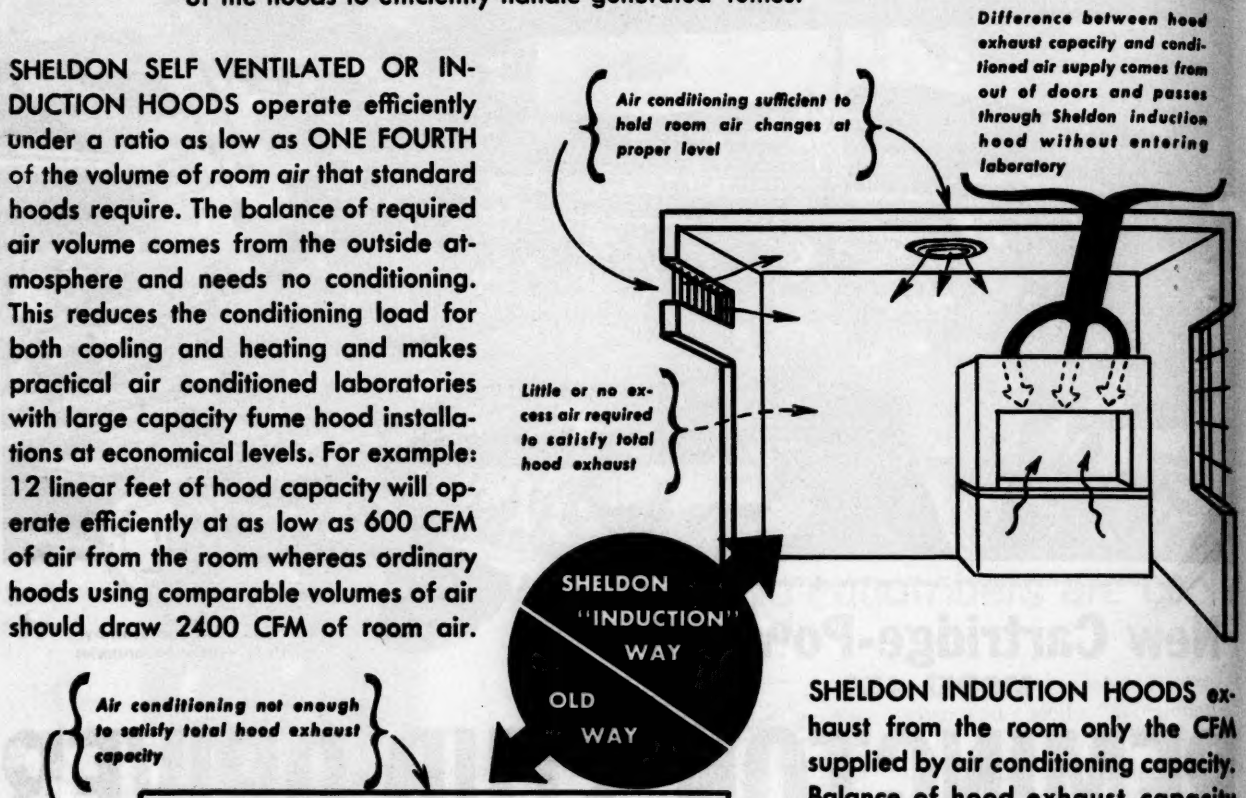
*Address*_____

*City*_____ *State*_____

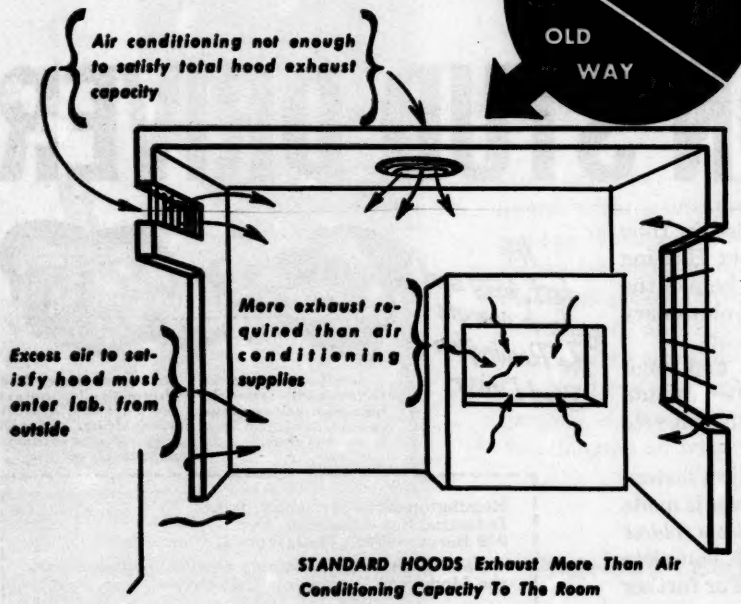
AIR CONDITIONED LABORATORY FUME DISPOSAL with SHELDON "INDUCTION" HOODS

SHELDON HOODS FOR CONSERVING ROOM AIR are designed to exhaust definite VOLUMES of air from the laboratory and hold the air changes within the room at predetermined levels. At the same time ample volumes of air pass thru the working area of the hoods to efficiently handle generated fumes.

SHELDON SELF VENTILATED OR INDUCTION HOODS operate efficiently under a ratio as low as ONE FOURTH of the volume of *room air* that standard hoods require. The balance of required air volume comes from the outside atmosphere and needs no conditioning. This reduces the conditioning load for both cooling and heating and makes practical air conditioned laboratories with large capacity fume hood installations at economical levels. For example: 12 linear feet of hood capacity will operate efficiently at as low as 600 CFM of air from the room whereas ordinary hoods using comparable volumes of air should draw 2400 CFM of room air.


Air conditioning sufficient to hold room air changes at proper level
Difference between hood exhaust capacity and conditioned air supply comes from out of doors and passes through Sheldon induction hood without entering laboratory
Little or no excess air required to satisfy total hood exhaust
SHELDON "INDUCTION" WAY
OLD WAY

SHELDON INDUCTION HOODS exhaust from the room only the CFM supplied by air conditioning capacity. Balance of hood exhaust capacity supplied by hood and does *not* enter laboratory and is *not* conditioned.


Air conditioning not enough to satisfy total hood exhaust capacity
More exhaust required than air conditioning supplies
Excess air to satisfy hood must enter lab. from outside

STANDARD HOODS Exhaust More Than Air Conditioning Capacity To The Room

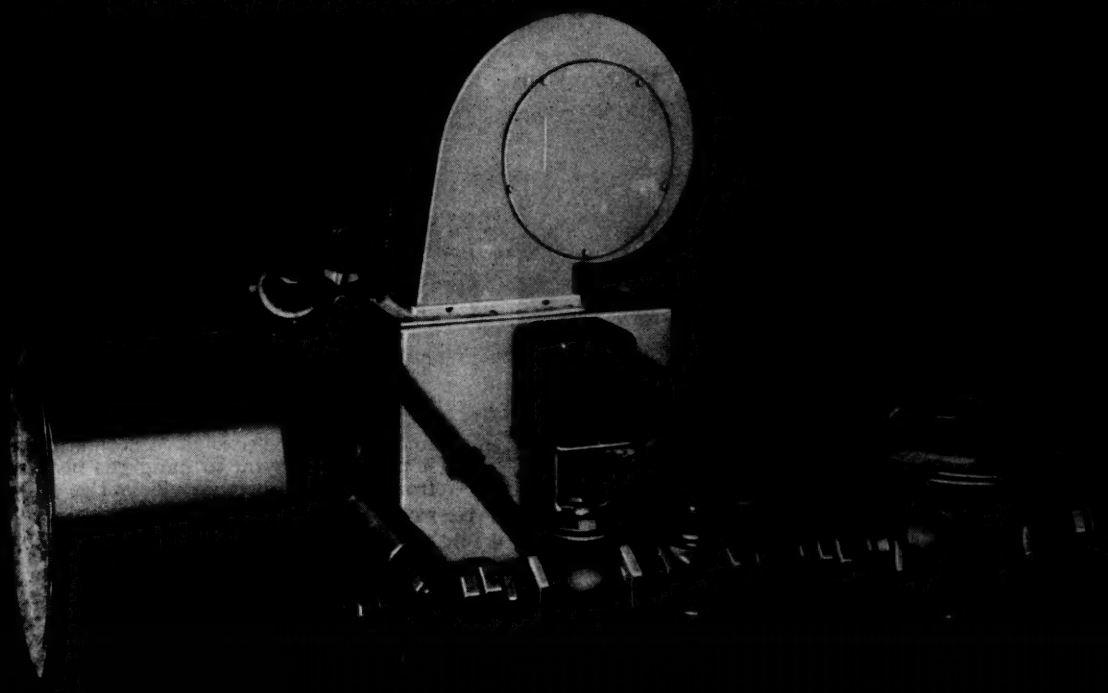
SHELDON INDUCTION HOODS are adjustable to meet laboratory requirements. Our sales engineers will be glad to work with you on definite installation requirements. Write or wire Muskegon, Michigan, for the nearest sales office and engineer.

E. H. SHELDON EQUIPMENT COMPANY

MUSKEGON, MICHIGAN

NEW ECLIPSE FAN-TYPE COMBINATION GAS & OIL BURNER

Changes to gas or oil fuels instantly, automatically



It's a complete package . . . ready for industrial and commercial heating installation

Here are the *facts!* Operates at peak efficiency with gas or oil. Burns mixed, natural, or LP gas (800 BTU to 3200 BTU)—no. 1, 2, or 3 fuel oil. Snap-switch changes Burner instantly to fuel selected. Automatically sets all necessary controls in operation.

"Clean-fire" starting delays fuel until blower delivers correct air for perfect combustion. Direct, electric spark ignition for oil—pilot ignition for gas. Safe, positive starting. Electronic control provides 100% efficient flame failure protection. New, built-in tuyere completes exclusive "rotary flame" action of burner.

It's a complete burner installation. Nothing else to buy or install. Just connect gas and oil lines, wire to power source and limit controls, and it's ready to go! No tuyere ramming. No bricking. No complex adjustments.

Has unlimited commercial and industrial uses. Capacities from 400,000 to 2,250,000 BTU. Available now.

ECLIPSE FUEL ENGINEERING CO., Rockford, Illinois
ECLIPSE FUEL ENGINEERING CO. OF CANADA, LTD., Toronto, Ontario

Eclipse

ECLIPSE FUEL ENGINEERING CO.
1099 Buchanan Street, Rockford, Ill.

☐ Please send your free catalog No. R-100.
☐ Have the Eclipse engineer call to discuss my problem.

*Firm Name*_____

*Individual*_____

*Address*_____

*City*_____ *State*_____

Announcing the most rugged TRANE gas unit heater ever built!

Now! A Heater Built Like a Boiler!

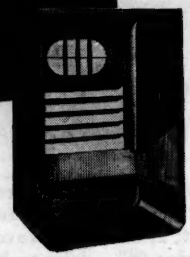
Heavier gauge steel throughout! Bigger, more powerful motor! New *steel* fan designed especially for unit heater application! Welded seams all around. Durable "Bonderized" finish.

Even the joints in the heat exchanger have come in for special treatment. TRANE has *eliminated* troublesome gaskets, furnace cement and other joining materials by using beaded and flanged connections to give you trouble-free joints as permanent as steel itself.

Features like these and other carefully engineered, exclusive details make it possible for you to hang gas heating from the ceiling more efficiently, more economically than ever before.

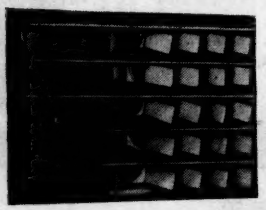
Have all the facts on hand when you plan your next gas unit heating job. Get the new TRANE Gas Unit Heater Bulletin just off the press. Write TRANE, La Crosse, Wisconsin, for the name of the TRANE Gas Unit Heater Distributor in your area.

These features mean extra years of trouble-free, thrifty operation

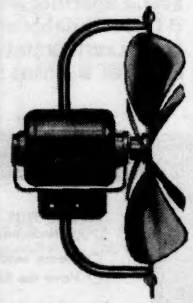


Rugged Construction—Heavier gauge metal throughout means extra safety, extra years of service.

Built Like a Boiler—No gaskets, no furnace cement. Beaded and flanged connections throughout.



Heat Where You Want It—Extra control of heat placement with patented TRANE Louver Fin Diffuser.



Special Trane Fan—Engineered specifically for unit heaters. Wide blade doesn't *chop* air. It pushes—quietly!

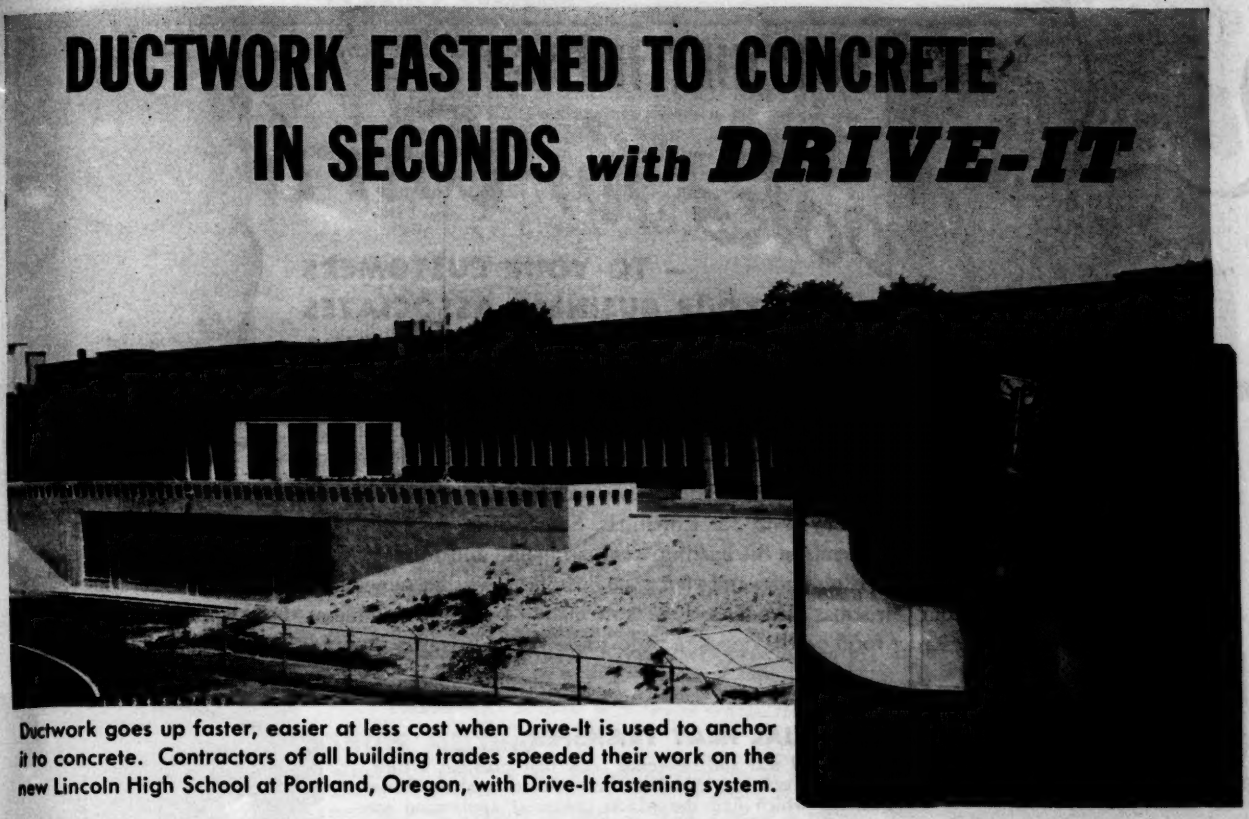
Approved by A.G.A.—Official tests prove this new unit not only complies with A.G.A. standards, but actually *surpasses* their national safety requirements.

TRANE

THE TRANE COMPANY, LA CROSSE, WIS.
Eastern Mfg. Division, Scranton, Pa.
Trane Company of Canada, Ltd., Toronto
Offices in 80 U.S. and 14 Canadian Cities

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

DUCTWORK FASTENED TO CONCRETE IN SECONDS with DRIVE-IT



Ductwork goes up faster, easier at less cost when Drive-It is used to anchor it to concrete. Contractors of all building trades speeded their work on the new Lincoln High School at Portland, Oregon, with Drive-It fastening system.

split-second fastening to concrete steel

Drive-It uses a small powder load to drive hardened steel pins into concrete or steel. No power lines! No drilling!

UL

DRIVE-IT is the only powder-actuated tool approved by Underwriters' Laboratory.

DRIVE-IT cannot be discharged accidentally due to the push and turn sequence. This, plus the large safety pad makes *DRIVE-IT* triple safe.

Exclusive Automatic Barrel Extension for fastenings inside junction boxes or other recesses.

DRIVE-IT is the only powder-actuated tool which requires but one standard power load regardless of penetration desired.

Exclusive Swivel Safety Pad easily rotated for getting into close quarter work.

DRIVE-IT "300", lowest cost fastening tool. Low original cost and low operating cost.

a drive-pin for every job

OVER 50 TYPES AND SIZES

MAIL THIS COUPON TODAY!

POWDER POWER TOOL CORP.

0712 S. W. Woods St., Portland 1, Oregon

Canada: Ammo Power Tool Co., Ltd.
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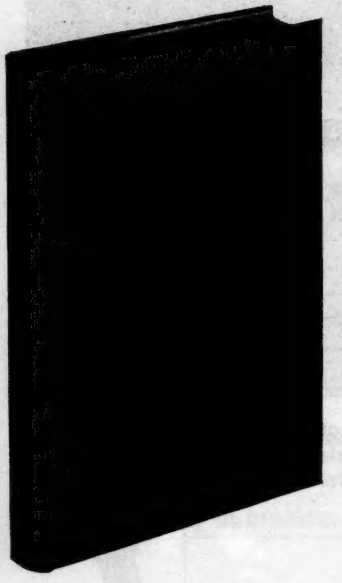

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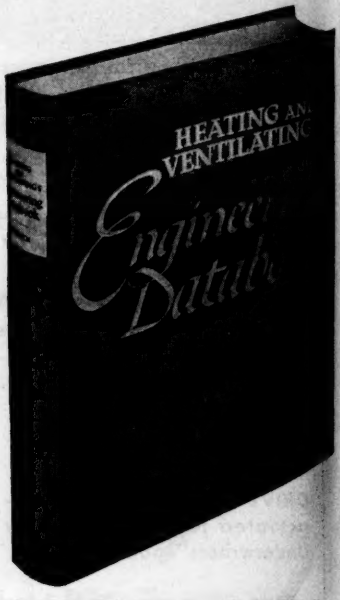

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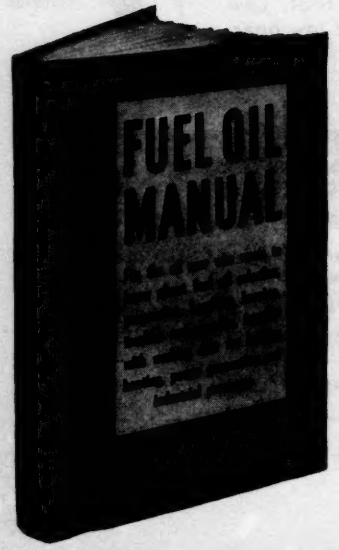

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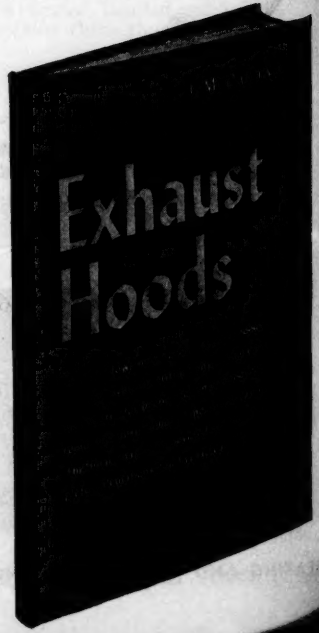

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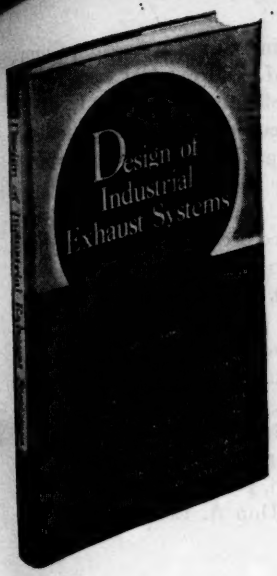

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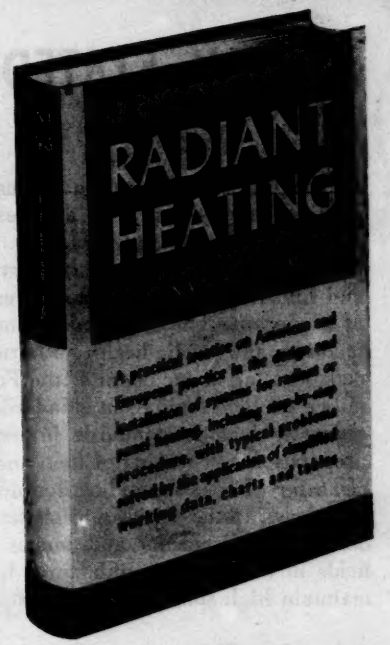

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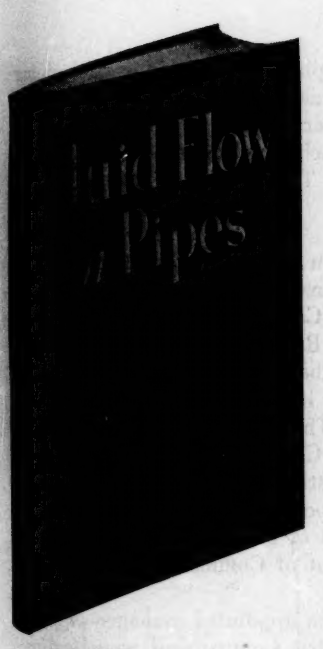

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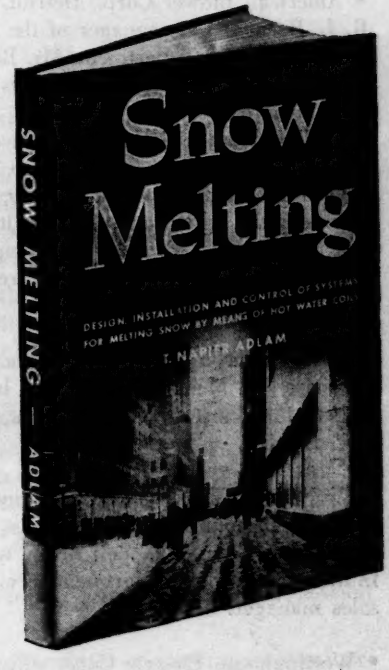

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BRIEFLY STATED

• The National Sanitation Foundation announced the publication of the first in a series of standards for the design, installation and operation of equipment in which public sanitation is a factor. Entitled "Soda Fountain and Luncheonette Equipment," the first set is the result of cooperative effort by soda-fountain equipment manufacturers and public health authorities from many states, collaborating as members of the Foundation's joint committee on food equipment standards. The series will subsequently include standards for equipment used in the preparation and serving of food and beverages and in the cleansing of cooking and eating utensils in all public eating places, in the washing of clothes in commercial laundering establishments and homes, and in many other fields in which the manufacturer has a responsibility to maintain high standards of sanitation in his product.

• American Blower Corp., Detroit, Mich., has appointed R. L. Bernhard as manager of the newly-created centrifugal compressor department. Mr. Bernhard has had more than 18 years of experience in this field.

• Willard Storage Battery Co., Cleveland, Ohio, is urging its distributors and wholesalers to install cooling equipment for storage of stock batteries or to make use of commercial cold storage, because its research has shown that batteries stored under low temperatures can be kept there up to 14 times as long before recharging is necessary.

• S. T. Johnson Co., Philadelphia, Pa., announced the purchase of Mears-Kane-Ofeldt, Inc., Bridgeport, Pa. Robert P. Johnston, vice-president, is in charge of the new division.

• William J. Weir has been appointed sales manager of wholesale accounts for Chase Brass & Copper Co., Inc., Waterbury, Conn. Mr. Weir began work for the company in the metallurgical department serving as condenser tube sales manager.

• Westinghouse Electric Corp. will expand its manufacturing operations in the Boston area soon with a $1.25 million building project at its Sturtevant Division plant. Operations in the new building will provide new jobs for an estimated 200 people, total employment reaching approximately 2,200 when the new facilities are fully manned.

• General Controls Co. opened a new plant in Skokie, Ill. Built at a cost of approximately $750,000, it has 60,000 square feet of floor space located on a five-acre lot. Additional land is available on the present site for future plant expansion.

• A new company, Eclipse Fuel Engineering Co., of Canada, Ltd. has been formed to handle sales and service of Eclipse products in that sector. New offices for the company have been established in Toronto, and will be managed by Gordon E. Bouvier.

• The Torrington Manufacturing Co., Torrington, Conn., has announced the election of Andrew Gagarin to the presidency of the company effective January 1, 1953, when S. W. Farnsworth, current president, will become chairman of the board. Mr. Gagarin is now vice-president of the company. He joined the organization in 1946, as a member of the production control department, and served as assistant to the vice-president in charge of manufacturing, and assistant to the president, before becoming vice-president in 1950.

• F. S. Cornell is the general manager of the new Permaglas-Heating Div., A. O. Smith Corp., Kankakee, Ill., asst. manager is J. F. Donnelly, recently elected president of the Gas Appliance Manufacturers' Association. Working with S. E. Wolkenheim, the marketing director for the new division, are J. S. Robinson, product manager; D. D. Williams, sales engineer; and Don A. LeRoy, sales promotion manager.

• Cory Corp. has announced the acquisition by long term lease of an additional manufacturing plant embracing approximately 52,000 square feet on 14½ acres of land in Grayslake, Ill.

• Latest developments in plastic patching for steel piping and an improved technique for developing better diesel fuels are described in government reports reviewed in the September issue of the Technical Reports Newsletter just released by the Office of Technical Services, U. S. Department of Commerce.

• Savings in construction costs may result from new fitting weight specifications that were presented at the national meeting of the Cast Iron Soil Pipe Institute, according to Homer E. Robertson, its executive vice-president. He says that they also will promote greater efficiency in handling cast iron pipe by plumbing wholesalers and contractors. The meeting was held at the Claridge Hotel, Atlantic City, during October. At the request of NAMP, the Institute sponsored specifications for two weights of soil pipe and fittings. Cooperating in the project was A. S. Best of the Commodity Standards Division, U. S. Department of Commerce.

• R. C. Robertson has been appointed manager of marketing of the General Electric Company's Home Heating and Cooling Department. Mr. Robertson was formerly manager of direct sales for the Company's Air Conditioning Div.

• Detroit Lubricator Co., the controls producing subsidiary of American Radiator & Standard Sanitary Corp., has changed its name to Detroit Controls Corp., effective October 1, 1952, to describe more accurately the major volume of the firm's business.

• J. Howard Smart has been elected president of Tuttle & Bailey, Inc., manufacturers of heating and air distribution products, it has been announced. Mr. Smart has been sales manager, second vice-president and secretary, and executive vice-president. He is also a director of Tuttle & Bailey, Inc., Tuttle & Bailey Pacific, The Hart & Cooley Company, Inc., and Hart & Cooley Mfg. Co., Holland, Mich.

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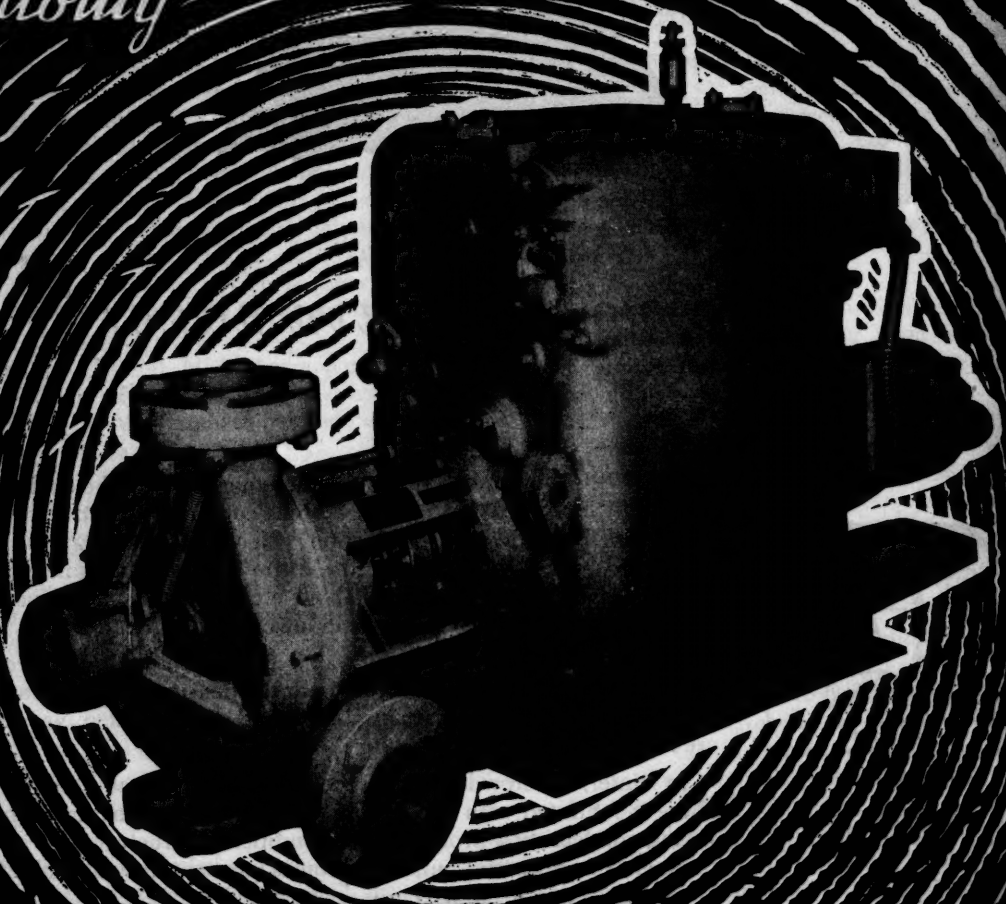

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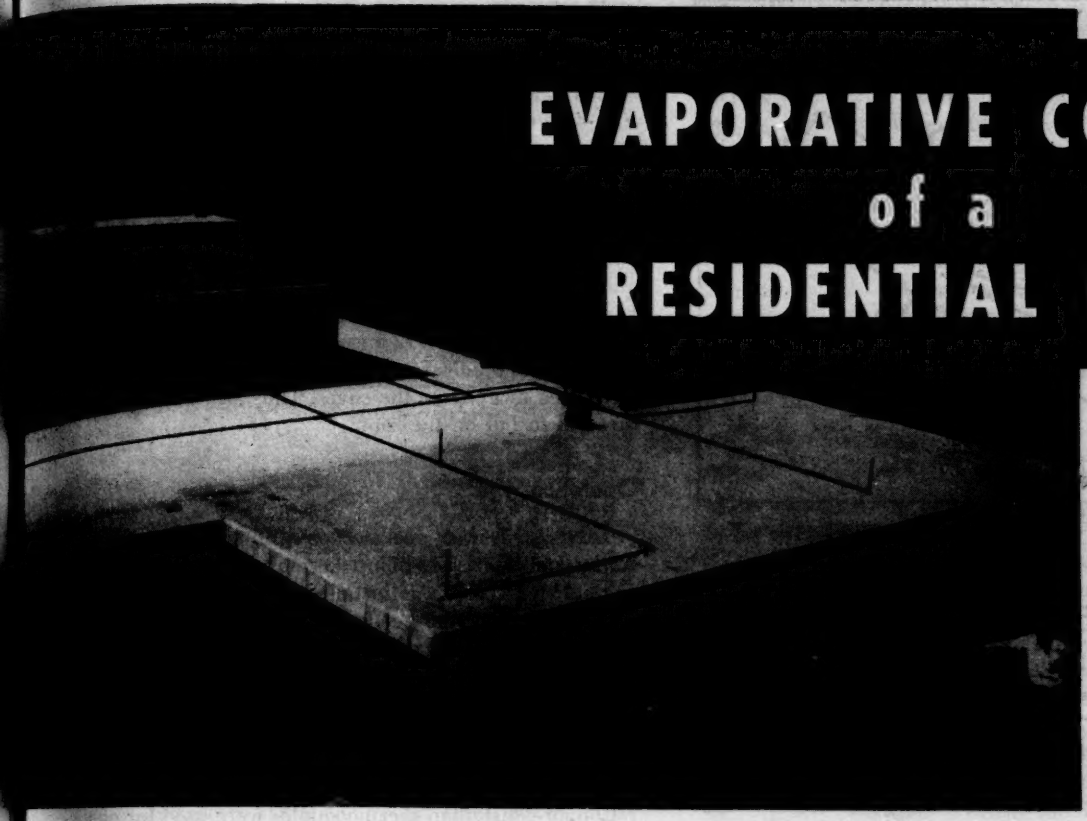
EVAPORATIVE COOLING of a RESIDENTIAL ROOF



R. A. BACON AND W. E. LONG

The University of Texas, Austin, Texas

This is the final of a series of three articles describing test results at the Acme Ceramic Housing Project in Austin, Texas. The first two articles, by Dean W. R. Woolrich and Professor W. E. Long in the May and September, 1952, issues, respectively, described liveability and heat transfer characteristics of the houses. The present article shows in detail the action of roof spray in modifying temperatures inside one of the ceramic houses.

WITHIN the past eight or ten years, particularly in the Southwestern United States, the attention of architects, engineers, and the building industry in general, has been focused upon the idea that there is a great need for research to establish better design features, better construction methods and better use of available building materials for protecting people in their homes from the heat of nature. Much progress has been made in all of these fields, and there is a growing consciousness in the professions and among home owners that functional design and the adaption of materials and of simple, relatively inexpensive construction methods to residential cooling are practical. With the acceptance of the unusual in residential construction and in the application of shading devices there has come a much needed, and very welcome, reduction in the cooling load required of the summer air conditioning unit.

One method of reducing the heavy cooling load is to apply a water spray to the roof of the house. The evaporation of water from the roof removes approximately 1,060 Btu for each pound of water thus evaporated.

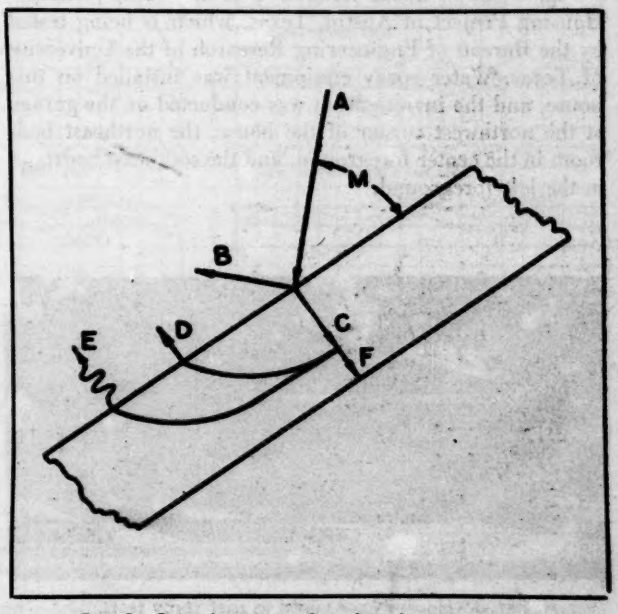


Fig. 1. Solar heat transfer of roof without spray.

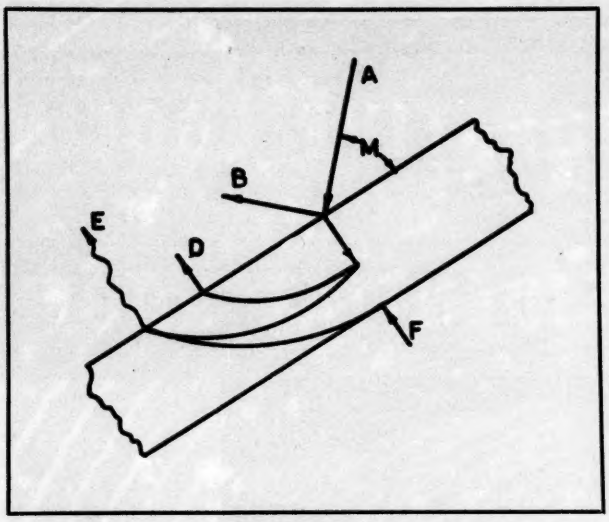


Fig. 2. Solar heat transfer of roof with spray.

The solar radiant energy on a surface normal to the direction of the sun's rays on a clear day has been determined experimentally to be between 300 and 400 Btu per (hr) (sq ft) at sea level, and at higher altitudes where there is less interference with the transmission of this energy, the amount is greater. However, only part of the radiant energy that strikes a roof is absorbed, as illustrated in Fig. 1. The total radiant energy striking the roof is represented by *A*, that portion which is reflected by *B*, and that which is absorbed by *C*. Some of that which is absorbed returns to the upper surface where it passes off by radiation, *D*, and by conduction and convection, *E*, while the rest of it remains in the roof mass or flows to the ceiling and then to the room. Fig. 2 illustrates the effect that might be obtained by evaporative cooling of the roof. The amount of heat, *E*, flowing to the air is considerably increased by the evaporation of water from the roof surface; the heat, *F*, flowing to the room is thus decreased, and at times there may be a flow of heat from the room to the roof.

Fig. 3 shows house number 4 of the Acme Ceramic Housing Project in Austin, Texas, which is being tested by the Bureau of Engineering Research of the University of Texas. Water spray equipment was installed on this house, and the investigation was conducted on the garage at the northwest corner of the house, the northeast bedroom in the center foreground, and the southeast bedroom in the left foreground.

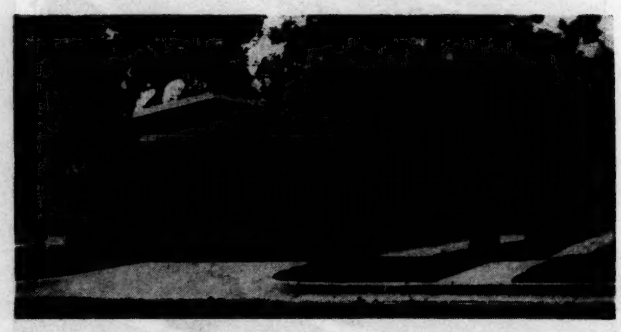


Fig. 3. House No. 4, used in roof spray tests.

The floor, over a crawl space, is composed of 4-inch joistiles with hollow tile filler between them, 1½ inches of concrete, and a finish of asphalt tile. The walls are of 6-inch hollow tile finished with plaster on the inside. Fig. 4 shows the roof construction over each of the three rooms tested.

The sprinkling system used in the test is shown in Fig. 5. The spray heads were on 12-inch risers and each head would sprinkle a circle or sector of about nine feet radius. The heads were spaced at about 12-foot intervals and the overlap of these circles and sectors gave good roof coverage. Heads for sprinkling 90-degree sectors were installed at the corners of the roof, for 180-degree sectors at the sides, and heads for sprinkling full circles were used away from the edges. Thus all of the spray was directed to fall on the roof.

Operation

The system was operated intermittently by an automatic control. A wet-bulb, thermostatically-operated, 24-volt solenoid valve was installed in the line to control the flow of water to the heads. The sensitive element of the wet-bulb thermostat was a vapor-filled bulb on the end of a 10-foot-long tube. This element was placed under a water spray, and the drop of vapor pressure opened the solenoid circuit and closed the water valve. Drying of the bulb closed the solenoid circuit and opened the water valve.

Copper-constantan thermocouples were used for obtaining all temperatures. Thermocouples for measuring roof temperatures had been installed at points in the roof during construction of the house, and those for air temperatures were placed at the desired points before the beginning of the test (see Fig. 4). All thermocouples were connected to recording potentiometers and the following temperatures were obtained in each of the three rooms tested.

(a) t_1, on top of the roofing felt under the chat.
(b) t_6, on the ceiling surface.
(c) t_7, in the room air, five feet above the floor.
(d) outside air dry-bulb temperature.
(e) outside air wet-bulb temperature.

Heat-flow meters, previously calibrated by the U. S. Bureau of Standards, and a recording potentiometer were used for determining the flow of heat between the ceilings and the rooms.

All doors and windows were closed and the test was started with the sprinkling system operating under ther-

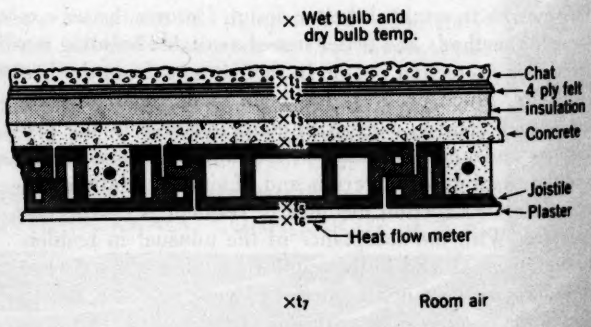


Fig. 4. Roof construction.

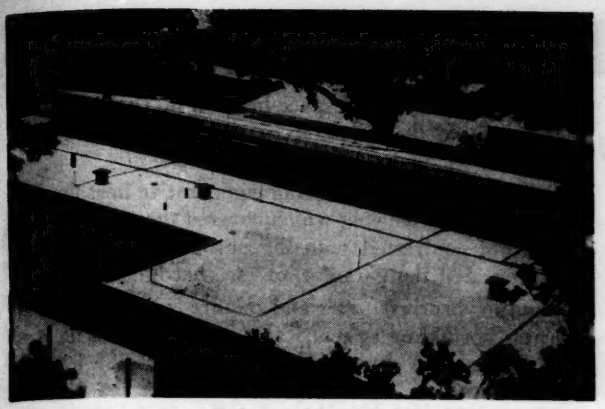


Fig. 5. Spray system on roof.

mostatic control. This part of the test was continued through July 21, 22 and 23, 1950. On the morning of July 24 the sprinkling system was turned off before it began to operate and the roof was permitted to dry during the day. The dry-roof part of the test was carried on through July 25, 26 and 27, and until the morning of July 28. The weather during the entire test period was typical of late July in central Texas with only a few scattered clouds and infrequent winds.

Test results have been graphed in Fig. 6, 7 and 8. Examination of the curves of outside air temperatures shows that one day was much the same as another. Temperatures at any given hour during the three wet-roof days differed from each other by not more than 3F. On these three days the maximum daily dry-bulb temperature of 93 to 94F occurred between 4 and 6 p. m. and the minimum daily temperatures of 71 to 73F occurred about 6 a. m. The wet-bulb temperatures ranged from 70 to 74F during this period.

On the three days of dry-roof testing maximum daily dry-bulb temperatures were from 93 to 96F, and the minimums were from 72 to 75F; the wet-bulb temperature ranged between 71 and 77F. During the last two days of the dry-roof testing the dry-bulb temperatures were 1 to 2F higher most of the time than during the other days. Wet-bulb temperatures during the dry-roof test period were 1 to 2F greater than they were during the wet-roof test period.

Results Compared

Results of the northeast-bedroom test are shown in Fig. 6. During the wet-roof test the heat flow was, at all times, from the room to the roof. At noon each day the maximum rate of 6½ to 7 Btu per (hr) (sq ft) was reached, and from 8 p. m. to 6 a. m. the rate was ¼ to 1 Btu per (hr) (sq ft). During the dry-roof test period the roof gave heat to the room for more of the time than it received heat from the room. The amount of heat it gave to the room daily was approximately four times as much as it received from the room, as shown by the positive and negative areas under the heat-flow curves. The heat that daily flowed outward through the wet roof entered the

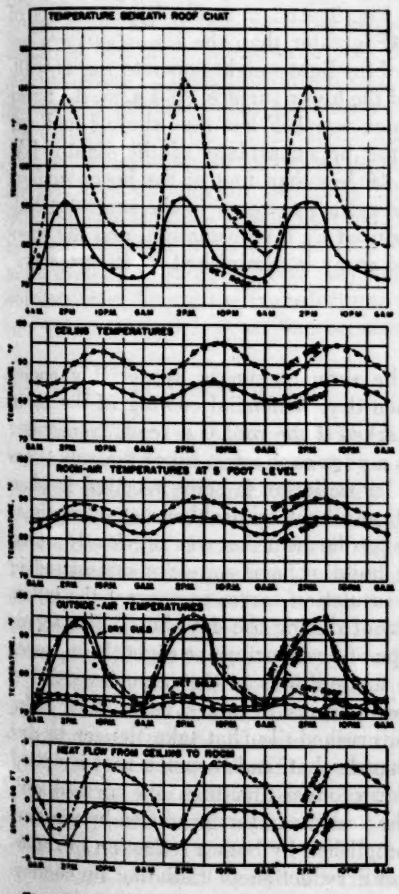
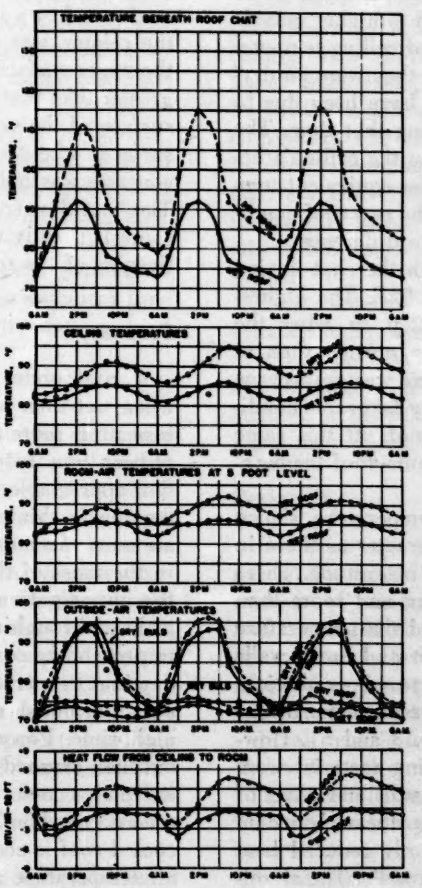

TEMPERATURE BENEATH ROOF CHAT
CEILING TEMPERATURES
ROOM-AIR TEMPERATURES AT 5 FOOT LEVEL
OUTSIDE-AIR TEMPERATURES
HEAT FLOW FROM CEILING TO ROOM

Fig. 6. Test results, northeast bedroom.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OUTSIDE-AIR TEMPERATURES
HEAT FLOW FROM CEILING TO ROOM

Fig. 7. Test results, garage.

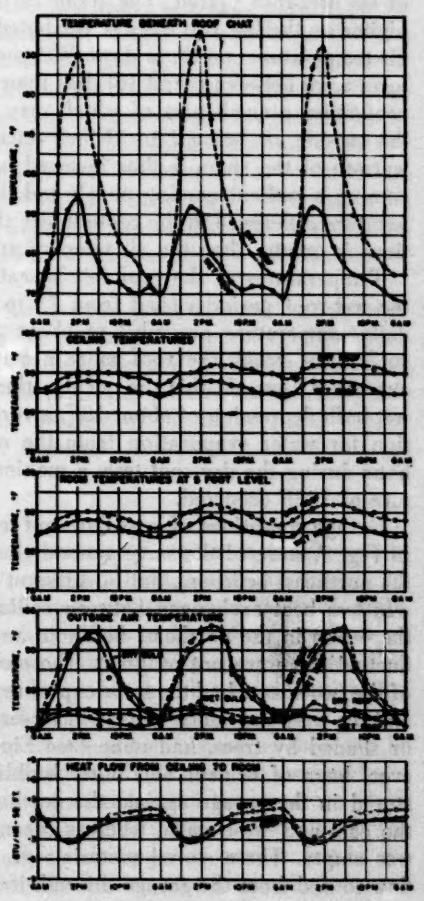
TEMPERATURE BENEATH ROOF CHAT
CEILING TEMPERATURES
ROOM TEMPERATURES AT 5 FOOT LEVEL
OUTSIDE AIR TEMPERATURE
HEAT FLOW FROM CEILING TO ROOM

Fig. 8. Test results, southeast bedroom.

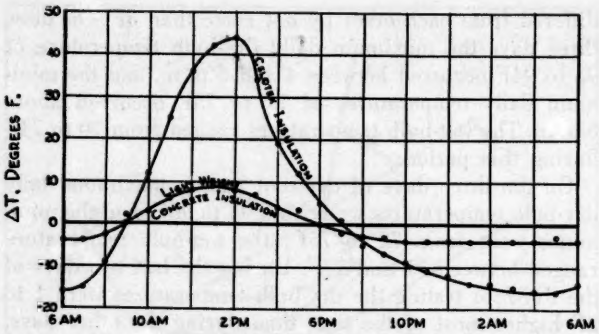

Fig. 9. Temperature differences across celotex insulation in southeast bedroom roof and lightweight concrete insulation in northeast bedroom roof on July 27 and 28.

room through the walls, windows and floor, which are not only exposed to the outside air but also partly to solar radiation. But the daily net gain through the dry roof left by way of the walls, windows and floor. Thus less heat found its way out through the walls, windows and floor when the roof was wet than found its way in, whereas the opposite was true when the roof was dry.

Room-air temperatures in the northeast bedroom during the wet-roof tests varied from 82 to 86F, and no appreciable difference from day to day is to be perceived. During the dry-roof tests the temperatures were from 2 to 5F higher than during the wet-roof tests. The 84F temperature at 6 a. m. on the first day of the dry-roof test was the lowest observation during this part of the testing and was probably due to the time lag of heat flow at the end of the wet-roof period. The trend of temperatures to be higher on the last two days is attributed to higher outside air temperatures on those days. Wet-roof ceiling temperatures were between 6 and 10F less than they were on dry-roof days, a small part of which may have been due to the outside air being 1 to 3F less during that time. The warmth of the room is thus lessened by the ceiling's becoming a radiant cooling panel, and the equivalent temperature difference in the room under the two roof conditions is greater than the air temperature difference.

Temperatures of the roof felt beneath the chat during the wet-roof period varied from 71 to 92F. The highest daily temperature prevailed at about 2 p. m. when the sun's rays struck the roof more nearly normal than at any other hour. At this time of day there was an average wet-bulb depression of about 18F, a very favorable condition for water evaporation from the roof. At this same hour during the dry-roof tests a maximum roof temperature of 122F occurred.

Garage conditions of heat flow and temperature, shown in Fig. 7, were of the same general character as those in the northeast bedroom, but of different magnitude. There was less heat exchanged between ceiling and room than there was in the northeast bedroom and the temperature fluctuations were not as great. The east and north walls of the two spaces had the same exposure to solar radiation, and the west and south walls, which were inside partitions or shaded by trees, had none (see Fig. 3 and 5). However, bags of cement and other building material were stored in the garage against the north wall and parts of the east and west walls, whereas the northeast bedroom was empty. These stored materials greatly reduced heat flow to and from the garage through its walls. The aluminum garage door was a ready transmitter of heat, but there were no windows in the garage as there were in the northeast bedroom. The concrete slab floor of the garage was on the ground in contrast to the bedroom floor which had the air of the crawl space beneath it. These and other factors caused the temperature and heat-flow conditions in the two rooms to differ.

One other factor influencing comparative heat flow was the crushed marble chat which covered the northeast bedroom roof contrasted with the porous crushed tile chat which covered the garage roof (see headpiece).

The tile absorbed water and required some days to dry after the sprinkling system was turned off. Peak temperatures beneath the garage-roof chat were 5 to 8F less than those beneath the crushed marble chat on the northeast bedroom. Although one day was allowed for the roof to dry before beginning the dry-roof part of the test, the garage roof reached a higher temperature each successive day, indicating that moisture was being evaporated from the chat all during the dry-roof period.

The southeast bedroom conditions of heat flow and temperature, shown in Fig. 8, were also of the same character as in the northeast bedroom, although differing greatly in magnitude. The roof sloped to the south and the sun's rays struck it more nearly normal than they did the flat roof over the northeast bedroom. Having a southern exposure, one wall of this room had the sun shining on it most of each day. But temperature fluctuations and heat flow through the roof were less than in the other bedroom because the roof was more heavily insulated. The performances of the celotex insulation in this roof and the light-weight concrete in the northeast bedroom roof are shown in Fig. 9. At 1 p. m. the upper surface of the celotex was 44F greater than the lower surface, but the upper surface of the light-weight concrete was only 9F greater than that of the lower surface. At 4 a. m. the upper surface of the celotex was 16F less than that of its lower surface, whereas the upper surface of the light-weight concrete was only 4F less than that of the lower surface. The heat flow from ceiling to room in the southeast bedroom is greatly reduced by this insulation, and the effectiveness of the roof spray is diminished by its presence.

Summary

A roof under the summer sun is appreciably cooler when wet than when dry. Beneficial cooling of the room beneath is more marked if the roof is a ready transmitter of heat than if it is a poor conductor. Since the only times that appreciable solar radiation is being received is when the sun is shining, any cooling problems at other times are ones of removing solar heat that was previously stored in the mass of the building, and were not considered in this investigation. Insulation serves to prevent the inflow of heat through a roof during the day, but it also serves to prevent the escape of heat during the night. It improves daytime temperature conditions in the room beneath but an uninsulated roof permits a cooler room during the night-time. Porous, crushed-tile chat takes longer to dry out than crushed-marble chat, and if such a roof is wetted it remains cooler for a longer time than one covered with crushed marble. The added comfort produced by a water-cooled roof is accomplished by both a reduction of room-air temperature and a reduction of radiation by cooling the ceiling.

What's New That's Unusual

T. W. REYNOLDS

Few engineers have the time or the interest to read thoroughly to keep abreast of the vast number of new devices introduced, many units so radically different as to make a strong departure from current practice. Therefore, it becomes evident that there is a need for a review of trends and things new or unusual that have been announced during the past few years. In this article, items not of general interest are avoided. Added details may be obtained by writing to Heating and Ventilating. Covered in article are items of interest to heating and air conditioning engineers.

IN a review of major technical periodicals for the past two years one is impressed with the vast forward strides made in the heating, ventilating and air conditioning fields. Each catalog and advertisement evidences the effort employed to make things invisible, portable, less annoying, serve more than one purpose, save labor and space, or fit into some small, out of the way or hitherto unused space.

This is particularly true for low cost housing where costs must be kept down to meet the purchasers' finances. Although not highlighted for other structures to the same extent, it is just as true with the larger commercial and industrial buildings where even wall thickness has been reduced from 12 inches to only 3 inches along vast perimeters and valuable space reclaimed.

Each such change in method, material or device, whether in building structure or its equipment, adds to the problems of both the manufacturer and engineer. It develops new troubles which, however, are always met by new methods, materials and devices. New developments of an even more radical nature may make current devices obsolete even before the manufacturer has sufficient time to secure testimonials regarding satisfactory use.

Putting Unused Space To Use

It is sufficient to point out without stating the usual "who or where" that for residential use there are available ductless furnaces and air conditioning units to fit crawl spaces; tall and narrow dehumidifiers for recessing; gas-fired boilers and furnaces for installation in the attic. There are also other gas-fired furnaces, and in some cases oil furnaces, to fit shallow in the floor, compact in the utility room (indoors or outdoors), or fit snug in the wall.

Some makes of furnaces may even be suspended from the ceiling to provide workable space, or a utility room below. One type of gas furnace is even advertised as a broom closet furnace. There is also the gas-fired or electric warm air furnace that fits a closet of larger size than just a broom closet. Small size and zero clearance makes such fit possible and also makes it suitable for zoning effect or separate rooms.

Still another small boiler is available, acceptable as a space saver, but installed out in the open. It is fitted with a table top for use in the kitchen. See Fig. 1. Five thousand of these were ordered for houses in Levittown, Pa. They are complete and self contained with burner, expansion tank, circulator, domestic hot water heater and controls and all inside one housing. Another manufacturer utilizes the table top to advantage for a water heater.

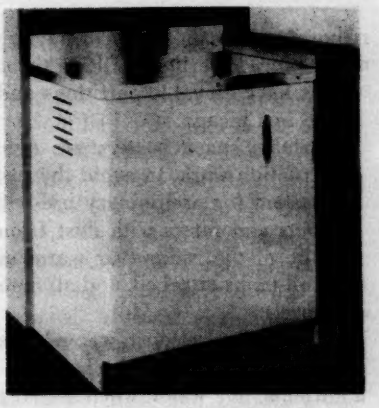

Fig. 1. Table top boiler installed as space saver in Levittown, Pa.

The gas-fired in-the-wall heater is widely used. It saves floor space by utilizing the height of wall from floor to ceiling. This shortens the flue, similarly to a gas-fired boiler when installed in the attic. With either heater or boiler, the usual masonry chimney from the ground up is eliminated. The heater can take combustion air from the living quarters, and the boiler from the attic or living quarters. One type of boiler, which is only 13 inches x 26 inches x 17 inches high, can supply 188 sq ft of radiation and is therefore suited for the heating of individual apartments.

Even radiators fitted with small blowers and a high velocity pump can be obtained for recessing. Radiators of this type have thermostatic and manual control and are set flush with the wall and painted to match. Quick heating is provided because of the blower, and copper pipes only ¾-inch diameter.

Portability

Getting things from here to there was a weighty problem in the past. Present day light weight substitutes, reduction of material used, division into multiple units, and the use of attached wheels and handles have lessened the problem. However, portability to increase flexibility of use does pose problems for the pipe fitter when utility equipment is moved, or even the space itself.

Small mobile houses are put on wheels so they can be moved to each construction job. In research studies, bathrooms and kitchens are moved about the structure which houses them to try out the effect of various locations. The structure may even be made larger or smaller, but in any event it is all done by flexible hose for mechanical services and with wheels or mountings on movable wall panels. A

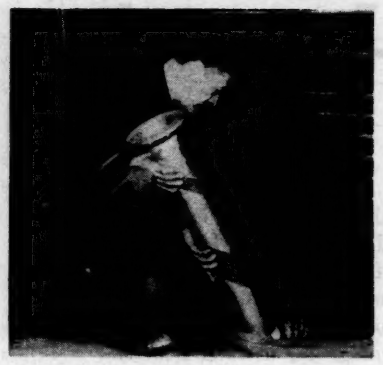

Fig. 2. Portable air mover for emergency or temporary ventilation.

laboratory for the study of daylighting goes even further by raising, lowering or tilting the ceiling as desired. Some offices have movable partitions and so has one apartment house in Chicago.

Portable space heaters are much used, especially on construction work, to avoid the rush to complete the heating system for preliminary use with the resulting fouling of ducts and filters with dust from construction. Heaters may be of the radiant or warm air type, electric, or oil with oil tanks attached, and all mounted on the same skids or wheels.

A very small electric water heater when immersed in a pail of water provides a portable hot water supply and additional hot water when the regular hot water heater is overloaded. Humidifiers, dehumidifiers and an electric cast iron tubular steam radiator are all made portable. The radiator is mounted on casters and contains an antifreeze and water solution for protection to –30F and hermetically sealed so that replenishment of fluid is not needed.

An electric radiant glass heater which produces infrared rays may be picked up by the handle and plugged in to an electric outlet wherever desired. A steam space heater, also portable, has a unit heater atop for better distribution of the heat. Some portable heaters on construction work use bottled gas. One portable electric heater also has a portable thermostat.

Many window fans are of light weight and made portable for movement from window to window, desk or other application. Some fans are reversible in rotation, or through reversal of the fan in the window. One is termed a five-way fan, or a fan used for window intake or exhaust, table or floor setting, or just as a room circulator. Some makes of window cooler units are portable. Since emergency ventilation is best provided by some portable device, what is known as a portable air mover, Fig. 2, can be readily carried to a zone requiring a quick removal of fumes. The air mover may be connected to a hose supplying steam or compressed air at high velocity, thereby inducing a large volume of air flow to ventilate a space.

Various aircraft industries and hangars have portable or mobile heaters and coolers. The temperature of cabins in large commercial planes can thereby be brought down in a brief time before the plane takes off. The mobile air conditioning units, mounted on trucks or trailers, are sometimes put to temporary use in a plant or auditorium or for spot cooling in the shop. A plane can be moved out for repair or fabrication to where the sun is no longer a factor due to on-the-spot cooling. Taking in all outdoor air to the mobile unit elimintaes any explosive or toxic hazard. In one case only the wing gas tank area of a plane was conditioned to dry properly a sealing compound and to ventilate for fume removal.

Work on The Ground Is Cheaper

Getting down to earth, or bringing the work to where conditions are more convenient, is faster and cheaper and a better job can be done. Thus, in one large building, prior to suspending the pipes from 25 ft poles, all insulation was completed on the ground, a protective coating applied, and the pipe then hoisted to its hangars. Similar procedure was followed for pipe in underground trenches. For bare pipe, use may be made of a machine that unloads pipe into a trench and then tamps as it backfills.

In Kansas City, Fig. 3, the floor slabs of a building under construction were poured on the ground and then hoisted by hydraulic jacks up steel poles at the rate of 4 ft per hour. This eliminated elaborate formwork and possible accidents to workmen due to elevation. This work was done by the Skyhook Division of the Long Construction Co. and the building was called a push button building, this reference relating to the push button control of the lifts. Presumably, the pipe fitters also worked on the ground.

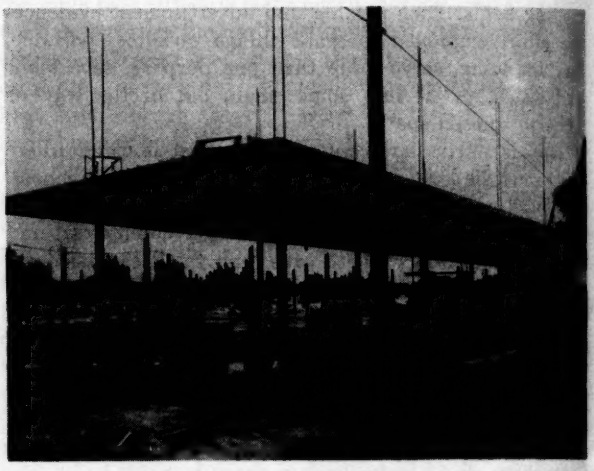

Fig. 3. Concrete floor slabs raised by hydraulic jacks. Photo courtesy, Official Bulletin.

Going Underground

We are not only getting down to the ground, but also getting far down into the ground in this country and abroad with experiments on underground coal gasification and in putting new life into tired old gas wells. In the last mentioned case, a muriatic acid treatment dumped down a shaft clears clogged geological pores and eats through the plugs. Natural gas is also stored underground where it can be recovered as required for peak demand, thus keeping pipe lines always at full capacity to reduce overhead and to make gas more economical for use. In one case a lumber camp with plenty of wood available finds it cheaper to pay for gas, which source is 200 miles away, than to pay its own labor for wood fuel. Even manufactured gas plants occasionally use natural gas for peak loads.

It has been suggested that heat pump calculations should also include the heat from rainfall carried into the ground. The heat pump once seriously written of as only a nice top to play around with is here to stay. Recently 39 heat pumps were installed for Florida schools. This eliminated soot and any need for boiler rooms, chimneys, fuel storage and firemen. Cooling may be obtained with this system when desired.

We are still using caves and mines for the raising of mushrooms, where such caves or mines have not converted to storage for records or defense production. Cost of commercial warehouse space is saved and constant temperature and humidity conditions obtained. Underground heat for snow melting, hot water, and other purposes, all from natural wells, is by now an old story and there have been cases of central heating of a house on a volcano.

Coin-Operated Fuel and Cooling Equipment

Coin operated vending machines seem to be finding a place in the heating and air conditioning industry. One make of window fan cooler unit can now be coin-operated and a bank in New Jersey, cooperating with a distributor of refrigerating equipment, installs a meter coin collecting device for such equipment bought on the installment plan. A coal vending machine automatically delivers a 60 lb bag of coal for cash. The coin controlled switch will handle from five to 75 cents. Buy as you need it, serve self, and 24-hour fuel service are proclaimed on accompanying placards.

The vending idea is good since the novelty of the arrangement and accompanying signs lead to regular truck deliveries and also eliminate telephone calls during the night, holidays and week ends. And so the idea has of late been extended, Fig. 4, to stoker coal briquets and fuel oil in 5 gal cans. In the winter the unit dispenses two kinds of coal and the fuel oil; in the summer, fuel oil, briquets and 5 lb bags of charcoal.

Spread of Air Conditioning

Just as we now generate steam up to 2,500 psi and 1,200F, so we can and do refrigerate down to within a few degrees of absolute zero. Compared to these maximums and minimums, the maximums and minimums of outdoor temperatures ever recorded is of no consequence and the type of house need not be dictated solely by the climate. For example, from the record we find, for the United States, only –66F at Yellowstone Park (Feb. 9, 1933) and 134F at Death Valley, Arizona (July 10, 1913); for West Palm Beach, Fla., only 31F (Jan. 28, 1940) and

Fig. 4. Vending machine for dispensing coal, fuel oil, and even charcoal.

Fig. 5. Compressed air harness designed to be worn under clothing.

100F (July 21, 1942). The average for this locality is 81F (summer) and 69F (winter), or 75F (year around).

Still it is not so long ago that the writer often was told air conditioning would seldom be found even in the better class homes, and then only with limitations as to rooms conditioned. Air conditioning, like radiant heating, was considered out of question for low cost housing. Heating of homes began in the same way—stoves and fireplaces being limited to certain rooms. We now find air conditioning in small homes on Long Island served by a 1 hp air conditioner so that one half of the total rooms can be air conditioned at a time, but the air conditioning can be switched about.

Those who can afford to purchase and operate a car with costly gasoline can afford to have complete air conditioning in their home. Looking at it one way, one might say that the smaller the house, the more money will be available for air conditioning and the less the cooling load will be. In any event, the time seems not far distant when mass production will bring air conditioning to every room of low cost houses. The problem has been one of selling the public on the idea that air conditioning is no longer a luxury and that it includes the commonly submerged name of heating, humidity control, and air cleaning.

One point that has been advanced of late is that the number, size and location of windows in an unconditioned house is determined to quite an extent by the desirability of obtaining cross ventilation, whereas in an air conditioned house the only requirement as to window location is privacy, furniture placement, exposure, daylight, and a good view. In an air conditioned house the need is lessened for screens, storm windows, louvers, and fans in the attic or elsewhere. Money so saved can be transferred to air conditioning the low cost house.

People are eventually going to be cooled in some way or other, whether by space air conditioning or air ventilated clothing. Studies are being made for such clothing for extremely hot radiant environments. Air cooled underwear has been used in one of our ship yards. This particular painter, Fig. 5, developed a harness which he placed under his clothing and connected it to a source of compressed air. Small holes in the hose let the air escape.

Even our jails are being air conditioned, although city officials of Miami, Fla., rejected it as being too attractive for their customers. In New York and elsewhere people ride the bus tops to keep cool, and if the bus tops are painted white, patrons find it much cooler, particularly when the bus stops. Houston, Texas, advertises itself as

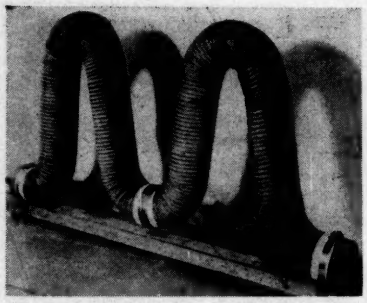

Fig. 6. Flexible ventilating ducts made of fiber glass fabric.

the best air conditioned city. It is said that troops moved in air conditioned ships arrive at their destination in better condition.

Trailer camps provide air conditioning for their trailer customers who find their metal enclosures too warm during the real hot weather. The owner of a trailer, if in the south, finds it cheaper to pay a higher rate in a trailer camp because of air conditioning than to move his home back north.

Air conditioning has been extended far and wide from the small but originally tough problem of an air conditioning unit in the crane cab with fume control by activated carbon, to the isolated structures housing employees around oil pumping stations serving pipe lines over 1,000 miles long in the Arabian desert. Both employees and equipment in the desert must be kept comfortable at 115F, high humidity and during dust storms. Similar temperatures are found even in the United States, as in switchboard rooms, where fuses must be at the right temperature or else they blow their tops.

It would be quite a task to give complete coverage to air conditioning for comfort and process work. New applications continually arise. Cigars that were previously fumigated to kill the cigar beetle are now, in some cases, air conditioned with bad effect on the insect but without the delay caused by fumigation which required a period for fumes to leave the tobacco. Windowless rooms, all blocked off from daylight, and with considerable heat from artificial light, are air conditioned. In the factories that supply our V belts, the belts lack stability without air conditioning. The belt fibers, during the course of manufacture, absorb varying amounts of moisture, so if the humidity is not controlled, the belts just stretch and do not match up in sets.

Manufacturers of air conditioning equipment have problems to which the specifier of such equipment gives little thought. The specifier might like air conditioning units available in several fractional sizes and they are made possibly in too many sizes for buying economy. Generally, width of the usual door seems to limit maximum size of the unit. This may be fortunate, because any increase in size results in less demand for the smaller sizes, in which event production quantity of such sizes fall off. Furthermore, the use of smaller sizes provides more flexibility and better distribution in air conditioning system.

Appearance of units is being improved and this helps to increase sales, because units then find wider application within air conditioned enclosures. A heat wave early in the summer also helps to increase sales, since one coming later generally causes the prospective purchaser to carry on as is for the balance of the season.

Air conditioners can now have what is called muggy weather control, and controls are proposed to regulate pressure within buildings. Registers are automatically controlled, some louvers no longer pass any light, and there are steel grilles for doors that won't rattle when the door is slammed.

I recall the gas-fired unit heaters that I had to work out to fit ducts in the 1939 Worlds Fair. Now one can obtain regular gas-fired duct heaters. Even flexible ventilating duct is obtainable. Ducts of this kind, Fig. 6, are made of fiber glass fabric on continuous steel spring wire. They may be cut to any length and like BX cable can be snaked through floors and walls.

For ducts and ceiling, there are manufactured reinforced access panels that do not sag or warp and are easily operated. Flush latches are made for any type of access door and there is adhesive backed felt tape for stopping rattle, dust and fume at joints.

Reduction of Air Conditioning Load

In chilled water installations, the chilled water may be circulated around fluorescent lights to remove most of their heat, or constant wattage ballasts may be installed to give cooler lighting. If the application is a bowling alley, a plexiglas curtain can be installed along the full width of the alleys at the foul line and the air conditioning load can be cut from say 15 to 10 tons.

Economy is also obtained by the reduction of lag characteristics through the use of light weight materials for the construction of ceilings combining radiant heating and cooling. One advantage of using the ceiling for cooling is to eliminate any effect it may have as a heating panel during the summer months due to heat absorbed from lights and windows. If the ceiling panel cannot handle all of the air conditioning load, it will at least substantially reduce the load and the amount of air conditioning ducts otherwise required. It is claimed that a ¾-inch pipe in the ceiling will carry as much heat away as would a 10-inch square duct.

The opened door adds to the air conditioning load and drafts. In industry and in cold storage warehouses, the door is frequently opened for trucks to pass through. So we now have flexible or bumpless rubber doors which also eliminate maintenance and damage to trucks and doors by absorbing shock. They close quickly and automatically and some have small windows of Plexiglass for a view of what's coming.

The window in tall buildings opened for cleaning inhales a lot of air and dust during the open window-cleaning process. One building has the windows opening in which makes for quicker and safer cleaning. Another office building (21 stories) uses an Otis Elevator Company electrical power operated platform which makes it safe and more economical for window washing, cleaning of stainless steel mullions, and repair of exterior walls. When the platform is not in use, it is parked on the roof.

Improvement in the arrangement and operation of roof sprays has made them more capable of effecting a worthwhile reduction in air conditioning load. Aside from this reason, any roofing of the asphalt type is preserved by the reduction in vaporization of volatile oils and temperature change of the surface from cloud to sun to thunder storm. The economics involved also include the cost of water.

Thermostatically operated devices are now used which cause flow of water to a flat roof at high roof temperature and stop flow when the roof is properly covered with water regardless of the temperature, thus conserving the cooling water. According to recent experiments, water shortage may be greatly reduced along the sea coast in the near future. A treatment has been worked out to provide economical desalting of sea water which when further treated, recovers salt, magnesium or other chemicals.

The flat roof of today covers many acres in some industrial plants and warehouses. In fact, boys and even older workers who have to cover vast floor areas are provided with roller skates. It is interesting to note that the usual plumbing code is based on a sloping roof and makes no allowance for reduction of leader size because of a flat roof, yet the run off of rain water must first be built up to a head before drainage starts. This may account for the pronounced cooling effect often experienced in large warehouses shortly after a good rainfall.

Roof sprays and water shortage bring to mind that the cooling tower lately has been vastly improved in appearance and sound baffling and in the removal of any nuisance mist and odors. The most radical departure in cooling towers is a recent air conditioning installation in the southwest where the tower becomes a 25-ton cooling fountain with its usual central statue and colored light illumination at night.

Reducing the Sun Load

Sun shading by exterior fins on tall buildings is no longer a novelty, but it is not settled yet whether the fins should be fixed or movable, horizontal or vertical, or a combination of fixed vertical with movable horizontal fins. Should they be used on four sides of the building and used whether or not the building is air conditioned? Would they be of equal effect on a residence since we leave the office before the sun is down?

In the Employers Insurance Building, Dallas, Texas, the air conditioning ducts are run outdoors to appear as vertical fins on the walls, but this was done for the saving of floor space within the building. Architectural treatment and any sun shading is incidental. A further advantage is the elimination of the usual pipe sleeve problem in floors and beams due to the routing of chilled water and drain pipes for the air conditioning system in the outdoor enclosures of the ducts.

The last word in a sun angle calculator was developed by the Libbey Ford Glass Company and the last word in solar heating seems to be a house in a Boston, Mass., suburb which is heated entirely by the sun. Large windows on the southern exposure help collect a lot of heat. Thus, in some cases the sun is wanted; more often not.

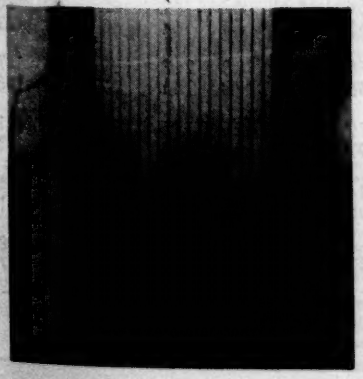

Fig. 7. Window ventilator or shade made of vertical fabric strips.

Fig. 8. Glass fiber roll pack permits filters to be cut to size.

Heat-absorbing glass can be used on the western exposure of a house for large unshaded windows and for store windows to reduce heat input. Some chain stores no longer provide display windows and even board up existing ones to keep down temperatures within and to preserve vegetables and baked goods. Only special items need sidewalk publicity and this can be provided by shallow breaks or window panels. There is, however, a liquid for coating windows said to absorb ultra violet rays which for three months will prevent the sun from fading merchandise.

Awnings are an old standby, but since they pocket heat, they can now be provided with vents. Sun-operated automatic louvers have been installed in the new Will Rogers Elementary School in Ventura, Calif. One can now buy manually operated window louver ventilators or shades, Fig. 7, which being in vertical strips, are easy to clean. Made as fabric strips, they can double as blinds or drapes. Vertical louvers do not collect much dust and they can be adjusted to direct daylight at any angle.

Even the garage door can be used for shading. One type of door which shades and keeps out rain, opens to extend as a 5 ft canopy. By this outward extension, it avoids interfering with any pipes on the ceiling within the garage.

Filters

Filtration covers a wide field from filters that remove oil, water and dirt from compressed air lines to those that trap kitchen grease to prevent its discharge to ducts or to the roof. For air conditioning systems you can roll your own filter, Fig. 8, and cut it to size if you purchase a newly developed glass fiber pack. Only the filtering element need be changed when servicing.

A device to show the home owner when to change filters is now on the market. Its indicator turns as the velocity decreases with increasing resistance of the filter due to dirt. And when a filter needs changing and the locality is New Orleans, there is a handy filtering cleaning service that uses industrial detergents to remove the dirt. This service company has special equipment for the purpose and mass servicing enables them to service cheaply.

A service company in St. Louis, Mo. employs midgets for its general air conditioning service. Since they are small and weigh only 100 lb they can get into long shallow ducts and other small spaces. The midgets pull along a vacuum hose, carry chemicals to destroy bacteria, and a small fire extinguisher for quick use on any fire started by cleaning.

Design Conditions for Snow Melting

William P. Chapman

National Tube Division, U. S. Steel Company

This supplements the article, Design of Snow Melting Systems, by the same author, which appeared in the April, 1952 issue of Heating and Ventilating. It offers several further considerations, the most important of which are concerned with actual slab requirements.

IT has been pointed out previously that more is required thermally of a snow melting slab than is expressed in the heating and melting of snow. After the snow is melted, the residual water film tends to cool due to evaporation, convection and radiation. These cooling effects, not to mention back losses, must be offset by heat supplied by the circulating fluid to the slab. The quantitative analysis of the total heat transfer is the requirement of the design.

Four basic equations were derived in the writer's April, 1952, article; and are repeated in an appendix at the end of this article as equations 3a, 3b, 3c and 3d. These equations offer the complete quantitative analysis assuming all of the slab to be free from snow. As explained then, if part of the slab were covered by even a few snowflakes, the slab surface would be partially insulated from convection, radiation, and evaporation effects. This insulating effect has been discussed briefly as the free area concept and will be discussed more thoroughly.

Free area can be defined as that area that is free from the insulating effect of snow. Notice that no mention is

TABLE 1 — HEAT OUTPUT AND FLUID TEMPERATURES FOR SNOW MELTING SYSTEMS

Relative Humidity, %	Snowfall inches of Water Eq. per Hr.	Free Area Ratio[1], A_r	q or t	Air Temperature, F: 0 — Wind Velocity, MPH: 5	10	15	Air Temperature, F: 10 — Wind Velocity, MPH: 5	10	15	Air Temperature, F: 20 — Wind Velocity, MPH: 5	10	15	Air Temperature, F: 30 — Wind Velocity, MPH: 5	10	15
				q = Heat Output, Btu per (hr) (sq ft); t = Fluid Temperature[2], F											
75	0.08	1.0	q	151	206	260	128	169	210	103	129	156	76	87	97
			t	108	135	163	97	118	138	85	98	111	71	76	81
		0.0	q	66	66	66	64	64	64	62	62	62	60	60	60
			t	66	66	66	65	65	65	64	64	64	63	63	63
	0.16	1.0	q	218	273	327	193	234	275	166	192	219	136	147	157
			t	142	169	197	129	150	170	117	130	143	101	106	111
		0.0	q	133	133	133	129	129	129	125	125	125	121	121	121
			t	99	99	99	97	97	97	95	95	95	93	93	93
	0.25	1.0	q	293	347	402	265	306	347	236	262	289	204	214	224
			t	179	207	234	166	186	207	151	164	177	135	140	145
		0.0	q	208	208	208	202	202	202	195	195	195	188	188	188
			t	137	137	137	134	134	134	131	131	131	127	127	127
90	0.08	1.0	q	150	204	258	126	167	208	100	125	150	72	80	87
			t	108	135	162	96	116	136	84	96	109	69	72	76
		0.0	q	66	66	66	64	64	64	62	62	62	60	60	60
			t	66	66	66	65	65	65	64	64	64	63	63	63
	0.16	1.0	q	217	271	325	191	232	273	163	188	213	132	140	147
			t	142	169	198	128	148	168	116	128	141	99	102	106
		0.0	q	133	133	133	129	129	129	125	125	125	121	121	121
			t	99	99	99	97	97	97	95	95	95	93	93	93
	0.25	1.0	q	291	346	400	264	304	344	233	258	283	200	208	215
			t	179	206	233	165	185	205	150	162	175	133	137	141
		0.0	q	208	208	208	202	202	202	195	195	195	188	188	188
			t	137	137	137	134	134	134	131	131	131	127	127	127

[1]Free Area Ratio, A_r = Snow-free area/total area.
[2]Based on ¾-inch pipe on 12-inch centers with 2-inch concrete cover.

made of the depth of the snow. If the snow falls unevenly, then the thickest depth will, of course, have greater insulation—less free area.

Free Area Ratio

For the sake of simplicity, a free area ratio will be introduced. Let A_r stand for the ratio of free area to total area. For a slab that has enough snow on it to exclude all evaporation, and all convection and radiation, the value of A_r will be zero. Conversely, for a slab that is completely free from snow, but has a residual water film, the value of A_r will be unity.

Imagine a steady snowfall upon a snow melting system that is in thermal equilibrium. As each flake drops into the water film, there will be a period of time required for enough energy to be transferred from the water to the flake so that the flake will be heated to 32F and then melted. During this time, the flake will form a slight insulating barrier over the water beneath it, thereby reducing the heat and moisture transfer to the air. For that length of time, A_r will be less than unity for the entire slab. If by a rare coincidence the slab melts the flakes exactly as fast as they fall, then A_r will be constant. Actually, of course, the flakes fall unevenly and A_r varies; therefore, the slab can never be in exact thermal equilibrium. Also, from a practical standpoint, it takes hundreds of flakes per square foot to reduce A_r to zero.

TABLE 2—RATE OF SNOWFALL[1]
(From U. S. Weather Bureau data; in inches of water equivalent; based on about 3700 readings per station.)

City	Frequency Distribution[2] — Rate of Snowfall[1] — No. of Readings				Assumed Design Rate of Snowfall[3]
	0.00 to 0.24	0.25 to 0.49	0.50 to 0.74	0.75 to 0.99	
Albany, N. Y.	2052	29	5	1	.16
Asheville, N. C.	463	5	1	0	.08
Billings, Mont.	1640	4	0	0	.08
Bismarck, N. D.	2838	0	0	0	.08
Boise, Idaho	1300	3	0	0	.08
Boston, Mass.	1323	11	4	2	.16
Buffalo, N. Y.	1871	23	3	1	.16
Burlington, Vt.	2390	9	0	0	.08
Caribou, Maine	1363	19	1	0	.16
Chicago, Ill.	1498	3	0	1	.08
Cincinnati, Ohio	1045	3	0	0	.08
Cleveland, Ohio	1569	2	0	0	.08
Columbus, Ohio	1351	4	1	0	.08
Denver, Colorado	1207	4	0	0	.08
Detroit, Michigan	1830	5	2	0	.08
Evansville, Ind.	916	5	1	1	.08
Hartford, Conn.	1514	44	9	3	.25
Kansas City, Mo.	1189	12	2	1	.16
Madison, Wisconsin	2370	5	2	0	.08
Minneapolis, Minn.	2703	7	0	0	.08
Oklahoma City, Okla.	613	8	4	0	.16
Omaha, Nebraska	1795	8	1	0	.16
Philadelphia, Pa.	891	10	2	1	.16
Pittsburgh, Pa.	1365	6	2	0	.08
Portland, Maine	2054	33	4	1	.16
St. Louis, Mo.	1088	5	0	1	.08
Salt Lake City, Utah	1482	5	0	0	.08
Spokane, Wash.	1545	11	1	0	.16
Washington, D. C.	533	7	2	1	.16
New York, N. Y.[4]					.16

[1] *Rate of Snowfall*, as shown in this table, refers to inches of water equivalent per six hours. The records were obtained at 1:30 A.M., 7:30 A.M., 1:30 P.M. and 7:30 P.M. from November 15th to February 15th during the years 1940 to 1949 inclusive. (For some cities such as Asheville, N. C., where the total reading were less than 3720, the reading are not for the full 10 years.) The difference between the sum of the frequencies and the total readings is the number of times the maximum temperature in the six-hour period was above freezing.

The units for the rate of snowfall, as shown in the column headings for frequency distribution are inches of water equivalent per six hours. In other words, the observer melted the precipitation and measured the depth of water. For Albany, only once was the water 0.75 inches or more in depth after a six-hour fall.

[2] *Frequency Distribution*, as shown in this table, refers to the number of observations at six-hour intervals in which the amounts of precipitation were measured when the maximum air temperature in the period was below freezing. The purpose of imposing this temperature restriction on the data is that any precipitation, rain, snow or sleet that falls during below-freezing temperatures will require melting. On the other hand, any precipitation falling at above-freezing temperatures will melt of its own accord.

[3] *Assumed Design Rate of Snowfall* is the tenth highest rate given in this record. Since the listings are for a six-hour period, it is assumed the design rate is twice the average rate; therefore, the design rate is taken as one third the greater rate for the interval containing the tenth highest snowfall rate. For example, the tenth highest rate for Albany lies between 0.25 and 0.49 so the design rate is 0.49/3 = 0.16.

[4] New York City record was not used in this tabulation since the records for that station were not comparable with those of the other stations.

Selecting Design Ratio

Qualitatively, A_r is difficult to appraise. As the snow changes density, the insulating effect of each flake will vary. And to make matters worse, as the density varies, so does the nuisance value. For example, if the design is for a bridge ramp, A_r must be kept quite high to keep the ramp clear. We know that systems with low values of A_r may not remain clear during a storm, but we also know that high values of A_r are expensive. As in all engineering design, there must be a balance between performance and economy.

As discussed earlier, the purpose of the slab will determine the necessary performance. For a bridge ramp A_r must be high, whereas for a private driveway A_r may be low. The private system may have to sacrifice the benefit of a high A_r for the cost of the system.

In addition to selecting a value for A_r, it is necessary to select values for the four variables of (1) air temperature, (2) wind velocity, (3) rate of snowfall and (4) vapor pressure—the climatic considerations.

Selection of Climatic Data

The four basic equations accounting for all slab surface heat and moisture transfer (see Appendix) include the four enumerated variables that must be obtained from Weather Bureau records. Slab output is the result of the combined effect of all four variables. This output we have defined as q_o, and it is the selection—or determination—of q_o that makes up the quantitative analysis of the heat and mass transfer.

A table showing the values of q_o for ranges of all four variables has been prepared (see Table 1), but before entering the table, the reader must have some knowledge of the prevailing climatic conditions that define the design state. Often personal experience will indicate the probable values for air temperature and wind velocity. An estimated value for rate of snowfall may be found in Table 2. The only remaining variable, vapor pressure, was a practically negligible effect, as can be seen in Table 1.

At first glance this may seem like a complete answer to the problem of selecting the climatic data. Actually, though, it is extremely crude, owing to the fact that extreme values for temperature, wind, and snowfall(s) may or may not occur simultaneously, according to local pattern, and thus may or may not be valid design criteria. Obviously the next best thing is to contact the local Weather Bureau and show the meteorologist Tables 1 and 2 and explain your problem of determining q_o. This step is apt to be a vast improvement over the personal selection of the data,

but there is still a further improvement. Unfortunately, the next improvement is tedious and expensive.

The real selection of q_o requires an extensive statistical analysis. On a national scale, the task is Herculean; on a local scale it is not as bad. The statistical analysis entails solving the four basic equations—after establishing the desired value of A_r—for every case recorded by the Weather Bureau. Some limitation is placed on the work when you consider only the cases where $t_a \leqq 32F$ and $s > 0$. Even then there will be many solutions required for every city. After tabulating the values for q_o, tables similar to Tables 3 and 4 can be prepared, except that for a local job, only one city would be considered. The tables shown are purely fictional examples of what might be done.

Invariably there will not be enough help in the local Weather Bureau office to analyze the data. They will, of course, let anyone see their records, and they will advise just what records to use. For example, they can reduce the number of months that should be studied, and can give references to some of the larger storms in that locality.

Significance of Statistical Analysis

Working out actual data for his city in forms like Tables 3 and 4 will enable the designer to advise his client on the probability of failure and operating costs; furthermore, the tables will be a great aid in selecting the size of the heating plant.

Table 3 is primarily designed for use in sizing the equipment and determining the operating cost. The value of A_r should be determined by the group before the analysis is started. Perhaps two or more values should be given. The columns for $t_a > 32F$ and $t_a \leqq 32F$ are used to determine the percentage of time the system may be expected to be in operation.* The column for number of hours of snowfall is used as a selling point for snow melting systems. The remaining columns represent the frequency of various loads on the heating system. For example, in the case of City 1, a slab output of 50 Btu per (hr) (sq ft) or less was adequate 1497 of the 3820 hours; the maximum load was 323. For that city the probable design load would be 300 Btu per (hr) (sq ft). By looking at Table 4, it can be seen that A_r never reached zero; however, since the maximum load for $A_r = 1.0$ was 323, it can be seen that A_r probably approached 0.60 under maximum conditions. That means that $q_o = 300$ would probably suffice for such jobs as bridge ramps or emergency drives.

*Note: As explained in the first article, it is desirable to operate the system whenever the air temperature falls to freezing or below. This permits quicker action when snow starts to fall.

Frequency of Failure

Table 4 is primarily for the purpose of predicting the frequency of failures ($A_r = o$). Another use might be in the design of very low cost jobs such as private driveways or walks. For example, in City 30, there was but one case of the load exceeding 175 Btu per (hr) (sq ft) for cases of $A_r = o$. Yet according to Table 3 there were 14 cases of q_o exceeding 400 Btu per (hr) (sq ft) when $A_r = 1.0$. Such a city would probably be in a region of low air temperatures and fairly high winds. Under such conditions the snow is very light but the heat and moisture transfer terms become very important.

Tables 3 and 4 have been emphasized because similar tables are necessary before the designer can predict, with great accuracy, exactly what his system must do. Also, an understanding of these tables will help the reader to visualize just what is happening during the life of the system.

Installation Practices

(1) *Installation*—It has been found satisfactory to use ¾-inch steel pipe on 12-inch centers as a standard coil. If hydraulic loads require it, the pipe size may be increased to 1-inch (but the slab depth must be increased accordingly.

TABLE 3—FREQUENCY DISTRIBUTION OF REQUIRED HEAT OUTPUT, q_o, AT SLAB SURFACE

For the years ——— to ——— during the five months November to March; for $A_R = 1.0$ (purely fictional examples)

City No.	No. of Hrs Without Snowfall		t_{am}*	No. of Hrs With Snowfall	Required Values of q_o, Btu per (hr) (sq ft)									Max. Value of q_o
	$t_a > 32$	$t_a \leqq 32$			0 to 50	51 to 100	101 to 150	151 to 200	201 to 250	251 to 300	301 to 350	351 to 400	401 and Over	
					No. of Hours									
1	27262	5230	25.3	3820	1497	153	379	1022	571	193	5	0	0	323
2	35168	428	31.4	716	372	193	112	36	3	0	0	0	0	246
..	....	....	...	....	...	...	...	...	...	...	..	..	..	...
..	....	....	...	....	...	...	...	...	...	...	..	..	..	...
..	....	....	...	....	...	...	...	...	...	...	..	..	..	...
30	21258	12563	18.7	2491	494	316	150	101	252	678	359	127	14	471

*t_{am} is the average air temperature for periods of no snowfall but at sub-freezing temperatures. The term is used in the equation $q_x = 6.0\ (33 - t_{am})$ where q_x is the estimated hourly heat output for periods of no snowfall and with a slab temperature of 33F.

TABLE 4—NUMBER OF FAILURES FOR VARIOUS SLAB OUTPUTS
(Fictional examples for cities and period covered by Table 3)

City No.	Slab Output, Btu per (hr) (sq ft)								Maximum Value of Sensible plus Fusion Heat of Snow Btu per (sq ft) (hr)
	0	50	100	125	150	175	200	225	
	Number of Failures*								
1	3820	2203	1469	548	198	51	1	0	204
2	716	304	95	42	15	1	0	0	196
..	...	...	...	...	..	..	..	..	...
..	...	...	...	...	..	..	..	..	...
..	...	...	...	...	..	..	..	..	...
30	2491	1606	1178	650	74	1	0	0	189

*A failure consists of snow accumulation ($A_r = 0$) for one hour. If snow accumulates for two consecutive hours, then the system would be charged with two failures.

The piping should be supported in such a manner that a minimum of 2 inches of concrete should be above and below the pipe—this requires a 5-inch slab for ¾-inch pipe and 5⅜-inch for 1-inch pipe.

If an insulating material is used, it is generally good practice to provide a moisture barrier between the insulation and the fill. A roofing material (such as a 55-lb felt) is often used as a moisture barrier. The joints should be mopped, and the fill made smooth enough, so that there will be no holes nor gaps for moisture migration. Also, the edges of the barrier should be flashed to the surface of the slab so that the ends are sealed.

If the pipe must pass through an expansion joint, then a protective coating should be applied to the pipe for a foot or two on both sides of the joint.

If the pipe is kept dry at all times—summer and winter—there will be no external corrosion problems.

(2) *Starting Capacity*—Boilers are often oversized from 15 to 25% to provide start-up capacity. This is especially true when there is to be an allowance for starting a system in the morning after a reduced temperature has been maintained during the evening. With a snow melting system, this start-up capacity is built-in. If the system is to be operated intermittently, the fluid temperature, when the system starts, may be down to 10 or 20F—hence the need for anti-freeze solutions. If the fluid temperature is expected to go to 120F during operation and the heat exchanger is fed with steam, then at the very start the heat exchanger will have about twice the output it will have during steady operation. This means that is is not necessary to allow extra capacity for start-up. If the system is operated at idle loads whenever the air temperature falls below freezing, it is still unlikely the heat exchanger should be oversized to allow for starting conditions, because the added output derived from the lower idling temperature should suffice.

(3) *Drifting and Draining*—Often the snow melting system will be so located that during periods of heavy winds there will be a tendency for the snow to drift. Drifts will, of course, add to the load, but they may not be impossible to handle. In such areas it may be permissible for A_r to be equal to zero. This will be a tremendous help if the rest of the system operates at $A_r = 1.0$. One other simple solution is to add more pipe to the area expected to be drifted. Along this same line is the problem of drainage. If the drainage can be carried to the drifting area, some snow will tend to wash with the drainage. It is essential that the drainage paths be kept warm to prevent re-freezing. Some sidewalk systems have trouble when the gutters tend to freeze and the curbs, which are cold, then start to cake with ice and the drainage starts to puddle. The solution is to pitch the drain so that piping can keep the drainage area warm.

(4) *Condensate as an Energy Source*—If considerably more steam is used in the heating system or process work than is needed for the snow melting system, the condensate might be sub-cooled to heat the circulating fluid. This system often provides snow melting for negligible cost. In the case where steam is purchased from a utility company, the condensate may actually be a free energy source. If the condensate is normally returned at, say 180F, it may be possible to subcool to 170F and thereby heat the circulating fluid to 150F. This is often sufficiently hot to operate the system.

APPENDIX

Basic equations for $A_r = 1.0$ (equation numbers taken from page 101, Design of Snow Melting Systems, Heating and Ventilating, April, 1952).

Equation for heat of evaporation

(3a) $q_e = (av + b)(p_{wv} - p_{av})\ h_{fg}$

Equation for sensible heat

(3b) $q_s = 2.6\ (t_f - t_a)\ s$

Equation for heat of fusion

(3c) $q_m = 746s$

Equation for heat transfer (convection and radiation)

(3d) $q_h = f_c\ (t_f - t_a)$

where $f_c = 11.4\ (av + b)$

When $A_r < 1.0$, then equations (3a) and (3d) must be altered by multiplying the right hand member of each by A_r.

Total of the four heat quantities is q_o, demand at slab surface. The symbols are:

$a = 0.0201$

$b = 0.055$

v = wind velocity, mph

P_{wv} = vapor pressure of water, inches Hg

P_{av} = vapor pressure of moist air, inches Hg

h_{fg} = enthalpy of saturated vapor at film temperature, Btu per lb

t_f = water film temperature, F

t_a = air temperature, F —

S = rate of snowfall, inches of water equivalent, per hour.

l.c.

Concentrations of Particulates Found in Air

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The accompanying chart was devised by the authors on the basis of available data and has appeared[1] in channels not ordinarily seen by many of our readers.

THE concentration of airborne dust and mist in the atmosphere varies with meteorological conditions and with human activity. Dust storms and volcanic eruptions produce unusually heavy concentrations which may affect large populations, but such events are happily rare. Here we are concerned not with the unusual but with the commonplace as we find it in everyday life.

In attempting to depict atmospheric concentrations in conventional units we were struck by the wide range to be covered. We have made the accompanying chart, plotted on logarithmic scale, to show conditions with which we have actually had to deal in practice.

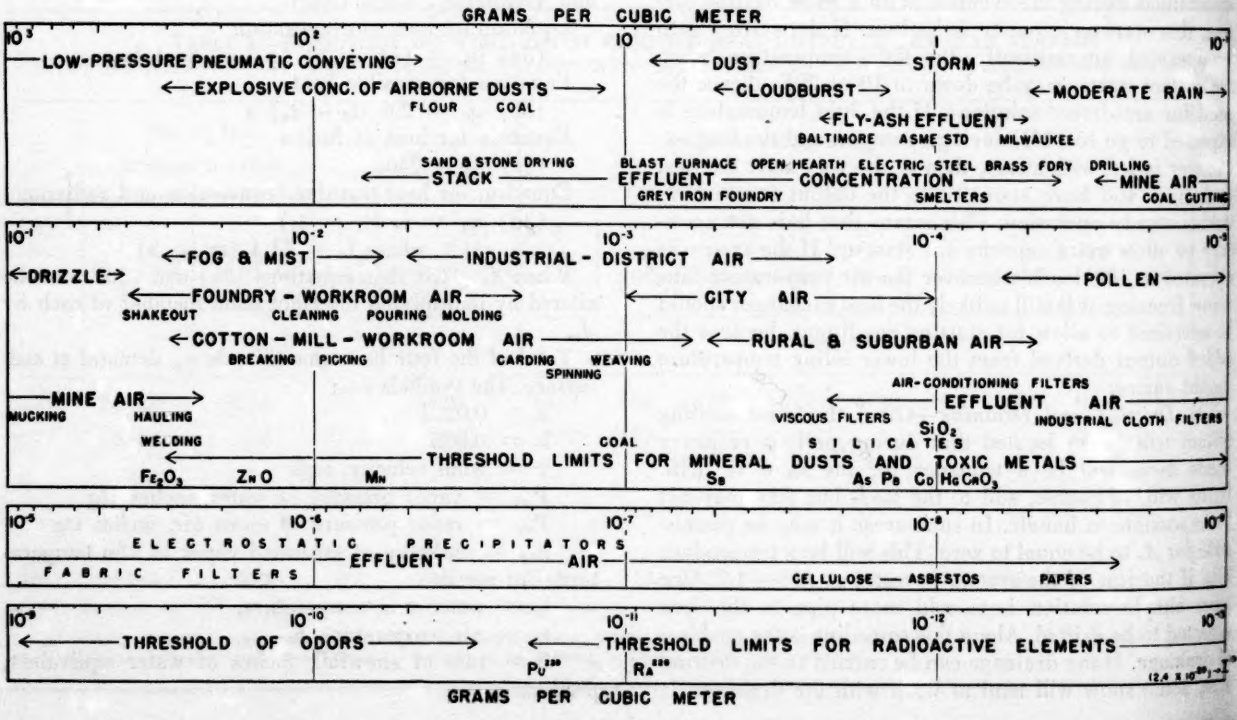
Fogs and mists are persistent aerosols in the absence of strong winds, not only because droplets are small enough to remain suspended in air for long periods, but because the concentration is sufficiently low (50 to 500 milligrams per cubic meter) so that rapid agglomeration and settling does not occur. If, under appropriate meteorological conditions, the concentration of a mist or fog increases beyond approximately 500 milligrams per cubic meter, particles coalesce and precipitate as fine rain or drizzle.

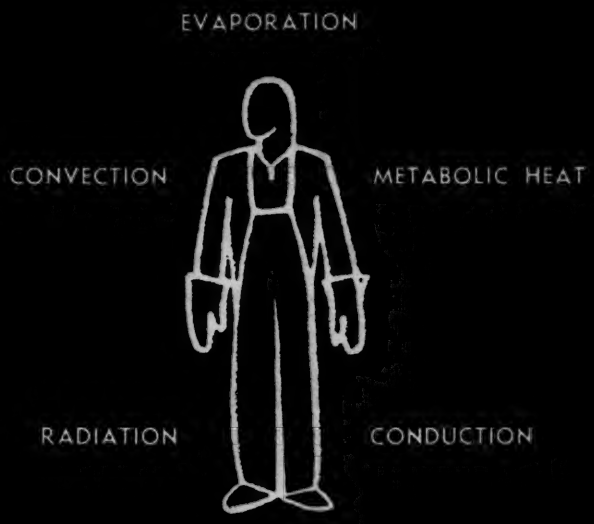
Clean country air contains as little as 0.1 to 0.2 mg. of dust per cubic meter, a large portion of which is organic matter. In manufacturing towns it may reach a level of 2.0 mg. or more. The air within a modern air-conditioned building should not exceed 0.2 to 0.3 mg. per cubic meter regardless of the concentration outside. In industrial establishments the dust concentration varies enormously; it will be less than 1 mg. per cubic meter in a well-controlled plant and over 500 mg. at the working face of a mine in which no dust-control measures are employed. An explosive concentration of a dust like wheat flour is about 20 to 30 grams per cubic meter. A dustiness of this concentration is very unstable because the suspension settles rapidly; an explosion usually follows a disturbance that jars dust off rafters and other dust-catching surfaces so that momentarily an explosive concentration exists.

We are not on firm scientific ground in suggesting some of these values because they have been reached by converting particle counts to weight. As a matter of fact the possible conversion error applies only to the small range from 10-3 to 10-4 which takes in the common toxic contaminants like silica and lead. The conversion we used assumes 0.1 mg. contains 5 million particles.

The authors would welcome criticism of this chart.

[1]Presented at annual meeting of American Industrial Hygiene Association, Cincinnati, April, 1952. Published through courtesy of Archives of Industrial Hygiene and Occupational Medicine.





Industrial Heat Exposures—Evaluation and Control

GEORGE F. HAINES, JR., and THEODORE HATCH

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This is a two-part discussion, complete in this issue, offering (1) a practical means of determining the nature and extent of heat stress imposed on workers in industry, and (2) examples of how such exposures were evaluated and controlled in a survey of the glass industry.

Heating and Ventilating Magazines Reference Section

Industrial Heat Exposures—Evaluation and Control

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Part 1—Evaluation of Thermal Exchange

BODY heat balance is a physiological requirement for comfort and health. When this balance is challenged by the heat of summer or the cold of winter, then man seeks forms of protection which will maintain the balance and enable him to live comfortably.

For the most part, man has been able to protect himself against the normal climatic variations; however, when the heat released by many industrial processes combines with the heat of summer, working environments are created which may present serious problems. In extreme environments, the body is just not able to get rid of the heat as fast as it is produced; as a consequence, the body temperature rises and if the exposure is prolonged, serious results are inevitable.

Fortunately, most industrial heat exposures today are not acute in the sense that there is a demanding need for control to prevent outright collapse. But even at the lower levels of exposure which do occur, heat is an important but often neglected factor directly responsible for uncomfortable and otherwise undesirable working conditions and indirectly responsible for reduced efficiency and production and increased absenteeism and accident rates.

The Industrial Heat Problem

There are four separate and distinct factors which influence the interchange of heat between man and his environment. They are:

(1) Air temperature.
(2) Air velocity.
(3) Moisture content of the air.
(4) Mean radiant temperature of the solid surroundings.

The industrial heat problem is one in which a combination of these factors produces abnormal physiological stresses on the human mechanism making it difficult to maintain body heat balance.

Industrial heat exposures may be classified as either *hot-dry* or *warm-moist*. The hot-dry exposures are the most common and may be found in the glass, steel, tin plate and many other industries where only sensible heat is added to the environment; air and wall temperatures are raised but the moisture content is not increased above that of the outside air. When the air is dry, the skin-air vapor pressure difference is great and the heat load imposed upon the man may be offset by the evaporation of sweat from the skin surface. The exposed worker experiences discomfort but, with acclimatization and adequate intake of water and salt, the stress is tolerated. Temperatures as high as 150F can be endured for short periods.

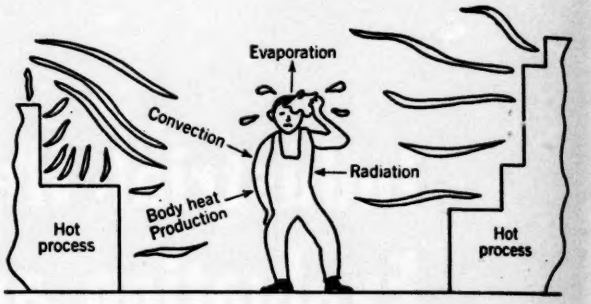

Fig. 1. Environmental factors in a typical industrial heat exposure.

Warm-moist exposures are found in dye shops, laundries, certain textile plants and in mines where, as a result of added moisture, the air is practically saturated with water vapor. In such exposures, the amount of sweat man can evaporate to the air is very limited and, regardless of acclimatization or other compensating mechanism, the exposure is inherently hazardous. Saturated environments exceeding 90F, for example, are physiologically unendurable for prolonged periods.

Fig. 1 illustrates the most common industrial heat exposure. Here the surrounding surfaces and air are both hotter than the human body, resulting in imposed heat loads by radiation from the surrounding surfaces and by convection from the air. To dispose of this heat plus the heat normally produced within the body, man must evaporate water (sweat) from his skin surface. The amount which can be evaporated, however, depends upon the dryness and velocity of the air. In order to understand the true nature of the industrial heat problem the influence of each of the heat interchange mechanisms between the body and its environment must be evaluated separately.

Body Heat Gains and Losses

The human body, like any physical body, lends itself to mathematical analysis of its heat exchanges with the environment. It may not be possible to predict thermal behavior in individual cases but, working with large numbers of observations on many subjects, trend lines are established from which useful physical constants have

been derived. The fundamental thermodynamic processes involved in heat interchange between the body and its environment may be described by the basic equation of heat balance, as developed at the John B. Pierce Laboratory of Hygiene:

$$M \pm D - V = \pm R \pm C + E \qquad (1)$$

where

M = rate of metabolic heat production within the body.

D = rate of change of body heat content.

V = rate of heat exchange by respiration.

R, C, and E = rates of heat exchange with the environment by radiation, convection and evaporation, respectively. All values in equation (1) are in consistent units, such as Btu per hour.

The rate of metabolism, *M*, is always positive. The rate of change of body heat content, *D*, may be either positive or negative, depending upon whether heat is being stored or depleted with a consequent rise or fall in body temperature. The rate of heat exchange by respiration, *V*, is negative in all practical situations. The evaporation loss, *E*, is positive since the dew point of the air must be below body surface temperature in any exposure of interest and heat is therefore given up to the environment by means of sweating. *R* and *C* are positive when the body surface temperature is above that of the walls and air respectively, and negative when it is below.

An analysis of the six variables in equation (1) follows:

(1) *Rate of Metabolism, M.* The heat produced within the body by metabolic processes, in Btu per hour, is calculated from the measured consumption of oxygen. The normal rate of heat production in the average size individual while resting is about 400 Btu per hr although it varies somewhat with race, sex, age, and the food eaten. At work the metabolic rate rises, as shown for various activities listed in Table 1.

(2) *Rate of Change of Body Heat Content, D.* When man passes from a normal to a hot environment, he heats up. However, because of his heat capacity and highly flexible sweating mechanism the resulting increase in body temperature is usually not great. For a 1F rise in average body temperature, the change in body heat amounts to about 120 Btu. Compared with the metabolic rate and for practical purposes of analysis, the change in body heat may be neglected.

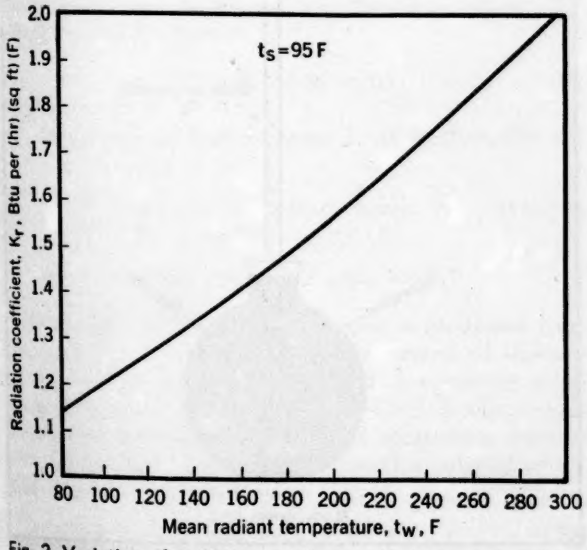

Fig. 2. Variation of radiation coefficient, K_r with mean radiant temperature, t_w.

TABLE 1—BODY HEAT PRODUCTION OF AN AVERAGE MAN DURING DIFFERENT DEGREES OF ACTIVITY.

Activity	Body Heat Production, Btu per hr.
Sleeping	255
Awake, quiet	300
Seated, at rest	380
Standing, at ease	430
Walking, 2 mph	760
Walking, 3 mph	960
Walking, 4 mph	1400
Maximum exertion	3000-4800

(3) *Rate of Heat Exchange by Respiration, V.* Another way in which the body exchanges heat with the surroundings is by the evaporation of water from the lungs. The expired air is saturated with water vapor, and the latent heat of vaporization, together with the heat required to warm the respired air to about 93F is taken from the respiratory surfaces. This rate of heat exchange, *V*, like *D* may also be neglected since it is insignificant compared to the metabolic rate *M*.

(4) *Rate of Heat Exchange by Radiation, R.* Radiation is the transfer of heat through space to the solid surroundings by wave motions, its intensity and wave length distribution depending upon the nature and temperature of the surface. The Stefan-Boltzman equation for heat transfer by radiation may be applied to man as well as to physical objects. It has the following form:

$$R = e\,K\,A_r\,(T_w^4 - T_s^4) \qquad (2)$$

or

$$R = e\,K\,A_r\,[T_w^3 + T_w^2T_s + T_wT_s^2 + T_s^3]\,(t_w - t_s) \qquad (3)$$

where

R = heat transferred by radiation, Btu per hr

K = universal radiation constant, 1.73×10^{-9} Btu per (hr) (sq ft) (F)

A_r = effective radiation area, 15.5 sq ft*

T_w = mean radiant temperature of the surroundings, F absolute

T_s = average skin temperature, F absolute

e = emissivity of the human body and surroundings

t_w and t_s = mean radiant and skin temperatures, respectively, F.

The emissivity of most hot process equipment varies from, say, 0.7 to 0.9; however, the methods employed in determining the mean radiant temperature, t_w, require no evaluation of emissivity. These methods either directly or indirectly measure the total radiant energy received at a particular location from the solid surroundings. The calculated mean radiant temperature is equivalent to a uniform temperature at which black body surfaces in the

*The human body is complicated in shape and radiation takes place freely from the exposed outer surfaces. Many portions of the body such as the arms, legs, and lower parts of the head radiate most of their heat to other portions. The equivalent surface of the body from which heat is *radiated* may be assumed to be about 15.5 sq ft for an average sized individual.

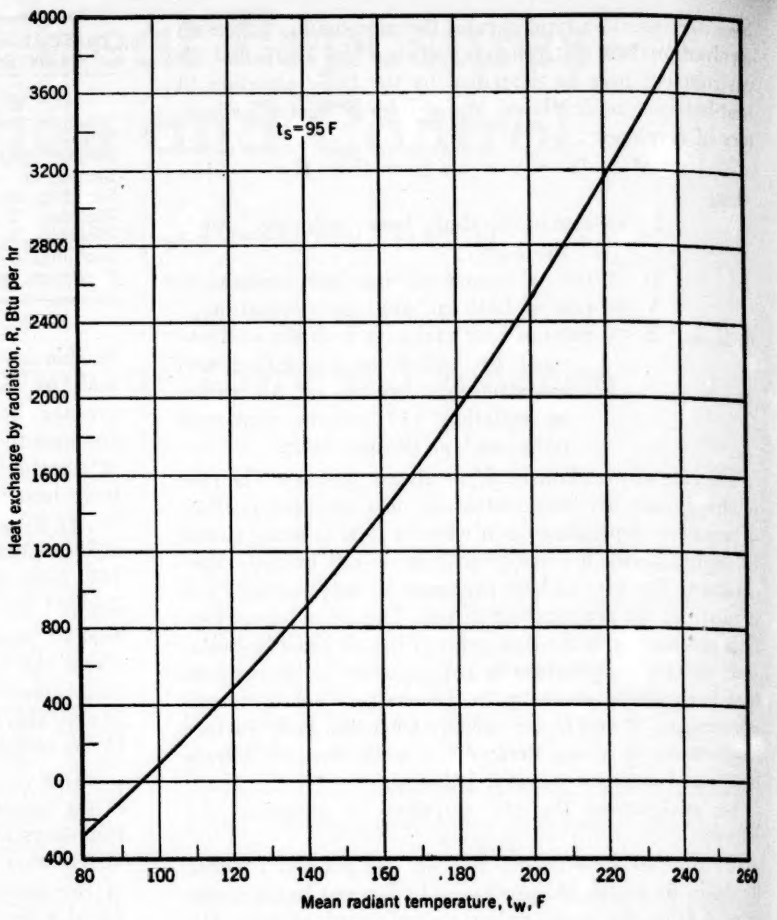

Fig. 3. Heat exchange by radiation between man and surroundings. Solutions of equation (4).

surroundings (emissivity = 1.0) would radiate. The emissivity of the human body and clothing also approximates that of a black body. Hence, e in equation (3) may be given a value of 1.0. Equation (3) may be further reduced to:

$$R = 15.5\ K_r\ (t_w - t_s) \qquad (4)$$

where

$$K_r = K\ \ [T_w^3 + T_w^2 T_s + T_w T_s^2 + T_s^3] \qquad (5)$$

Since t_s may be considered constant at approximately 95F, the coefficient of heat transfer by radiation, K_r, varies only with t_w as shown in Fig. 2. The heat transferred by radiation between man and his surroundings may be calculated from equation (4) or obtained directly from Fig. 3.

The mean radiant temperature, t_w, is obtained with the Vernon globe thermometer, Fig. 4, which consists of a hollow 6-inch metal sphere* containing an ordinary mercury thermometer with its bulb at the center. The sphere is painted flat black so that as a black body it will absorb all incident radiation on its surface. The globe thermometer reaches equilibrium with its environment within about 20 minutes exposure, after which the heat gained by radiation is balanced by the heat lost by convection. If the temperature of the globe exceeds that of the air, the radiation gain, R, is given by

$$R = 0.95 \times 1.73 \times 10^{-9}\ \ [T_w^4 - T_g^4] \qquad (6)$$

and the convection loss C has been found by Bedford and Warner to be:

$$C = 0.169\sqrt{V}\ (t_g - t_a) \qquad (7)$$

where R and C are in Btu per (sq ft) (hr).

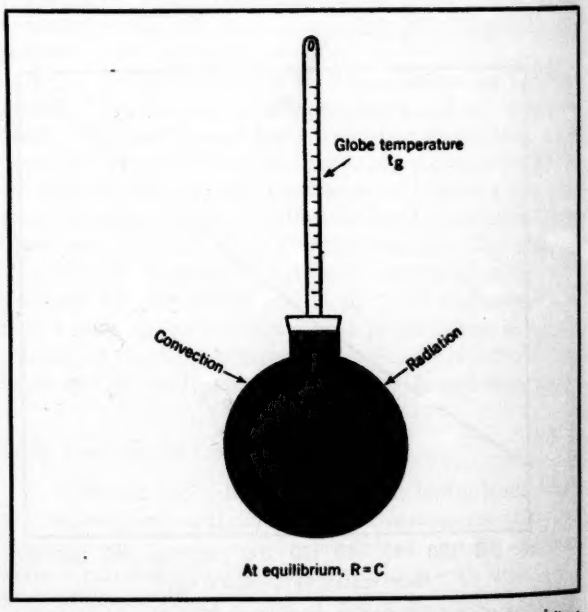

Fig. 4. Vernon globe thermometer for determining mean radiant temperature.

*An ordinary toilet float bulb has proved to be an excellent substitute for the 6-inch metal sphere.

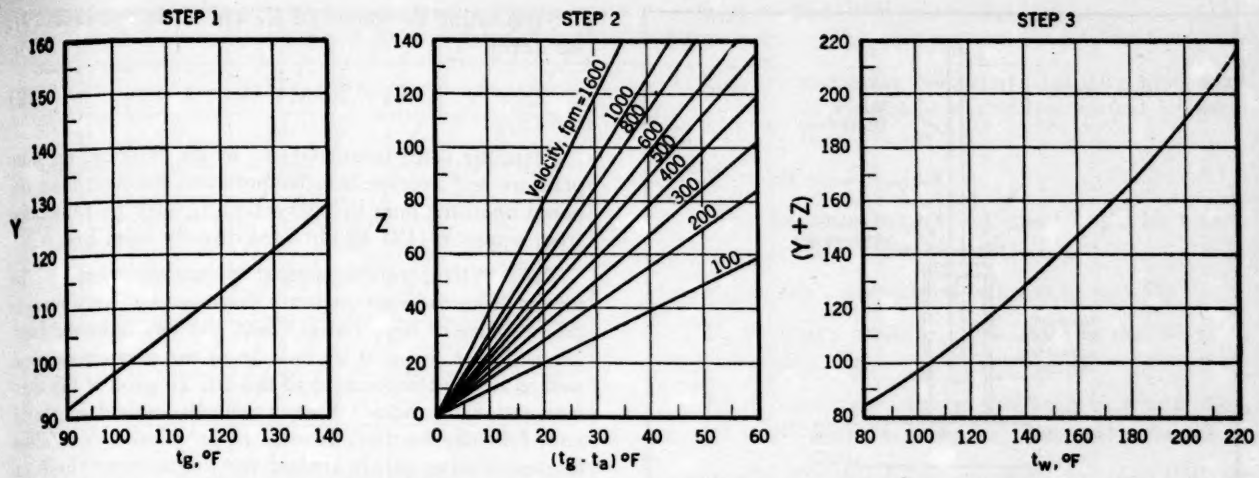

Fig. 5. Graphical solutions for equation (8) for determining the mean radiant temperature.

Example: The following measurements were recorded in an industrial heat exposure:
Globe temperature, t_g = 131F; air temperature, t_a = 92F; air velocity, V = 400 fpm. Determine the mean radiant temperature.

Solution: Step 1; at t_g = 131F, Y = 122
Step 2; at (t_g — t_a) = 39F and V = 400 fpm, Z = 78
Step 3; at (Y + Z) = 200, t_w = 208F.
Note that Y and Z are the right-hand members of equation (8).

T_w and T_g = mean radiant temperature and globe temperature, respectively, F absolute
t_g = temperature of globe thermometer, F
t_a = temperature of air, F
V = air velocity, feet per minute.

At equilibrium R = C and

$$T_w^4 \times 10^{-9} = T_g^4 \times 10^{-9} + 0.103\sqrt{V}\,(t_g - t_a) \quad (8)$$

Thus, if the air temperature, the globe temperature and the air velocity are measured, the mean radiant temperature can be calculated from equation (8) or obtained directly from Fig. 5.

(5) *Rate of Heat Transfer by Convection, C.* Convection is the exchange of heat between the body and the surrounding air. The rate of heat transfer by convection varies with the difference in temperature between the body surface and the air and with the air movement. The equation has the form:

$$C = K_c A_c (t_s - t_a) \quad (9)$$

where

C = rate of heat exchange by convection, Btu per hr

K_c = coefficient of heat exchange by convection, Btu (per hr) (sq ft) (F)

A_c = effective convective area, sq ft.*

Even under still air conditions heat is dissipated from the body by natural convection, the amount of which is proportional to the fourth root of the temperature difference between the body and the air. The following simple expression, however, has been found adequate to describe the relationship between K_c and V over a range of velocities from 15 fpm to 600 fpm.

$$K_c = k\sqrt{V} \quad (10)$$

*The equivalent surface of the body from which heat is exchanged *by convection* for an average sized individual is about 19.5 sq ft.

Experimental determinations have shown that K_c varies with body build, body position and, for the same measured velocity, even with the direction and complexity of air movement. With still air conditions values of K_c vary because of body movement and variations of natural convection currents. At Fort Knox, in a wind tunnel with linear horizontal flow, and with subjects standing nude, the relationship between K_c and V was found to be:

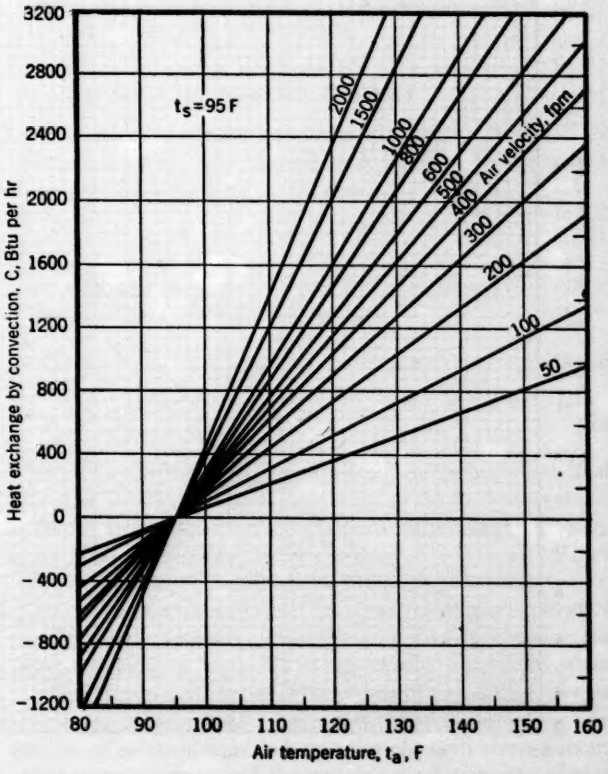

Fig. 6. Heat exchange by convection between man (skin temperature 95F) and surrounding air.

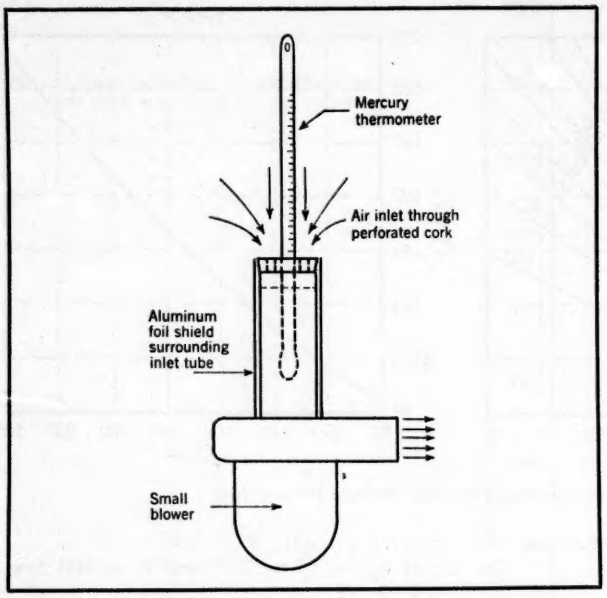

Fig. 7. A shielded aspirating thermometer for measuring true air temperature.

$$K_c = 0.11 \sqrt{V} \qquad (V \text{ in feet per minute}) \qquad (11)$$

The rate of heat loss by convection per unit of body area from light clothing was found not to differ greatly from that of the nude man, despite the greater area of the clothing. This, of course, does not hold true in the case of bulky winter clothing where insulation is heavy.

Substituting the values of K_c and A_c in equation (9), we have:

$$C = 2.1 \sqrt{V} (t_s - t_a) \qquad (12)$$

From the three measurements of air velocity, air temperature and average skin temperature, the heat load imposed upon the man by convection, C, may be calculated from equation (12) or obtained directly from Fig. 6.

The air temperature is most commonly measured by means of an ordinary mercury thermometer; however, in the presence of high radiant heat, the thermometer reading will be influenced by heat from the surroundings as well as by the temperature of the air. To protect the thermometer from radiant heat, a reflective shield of aluminum foil may be used. It must be large enough to allow free circulation of air around the thermometer bulb or, better still, a rapid current of air may be passed over the thermometer bulb. This is accomplished by either drawing the air over the bulb or by rotating the thermometer so that the bulb passes through the air. Fig. 7 illustrates a simple and accurate instrument employing both measures of protection against radiant heat. It consists of a mercury thermometer enclosed in a heat-reflecting jacket through which air is drawn by a small blower.

The air velocity is difficult to measure because of the complexity of air motion frequently encountered. For the assessment of the warmth of an environment, account must be taken of eddying currents as well as directional velocity. In fact, the coefficient of heat transfer by convection in-

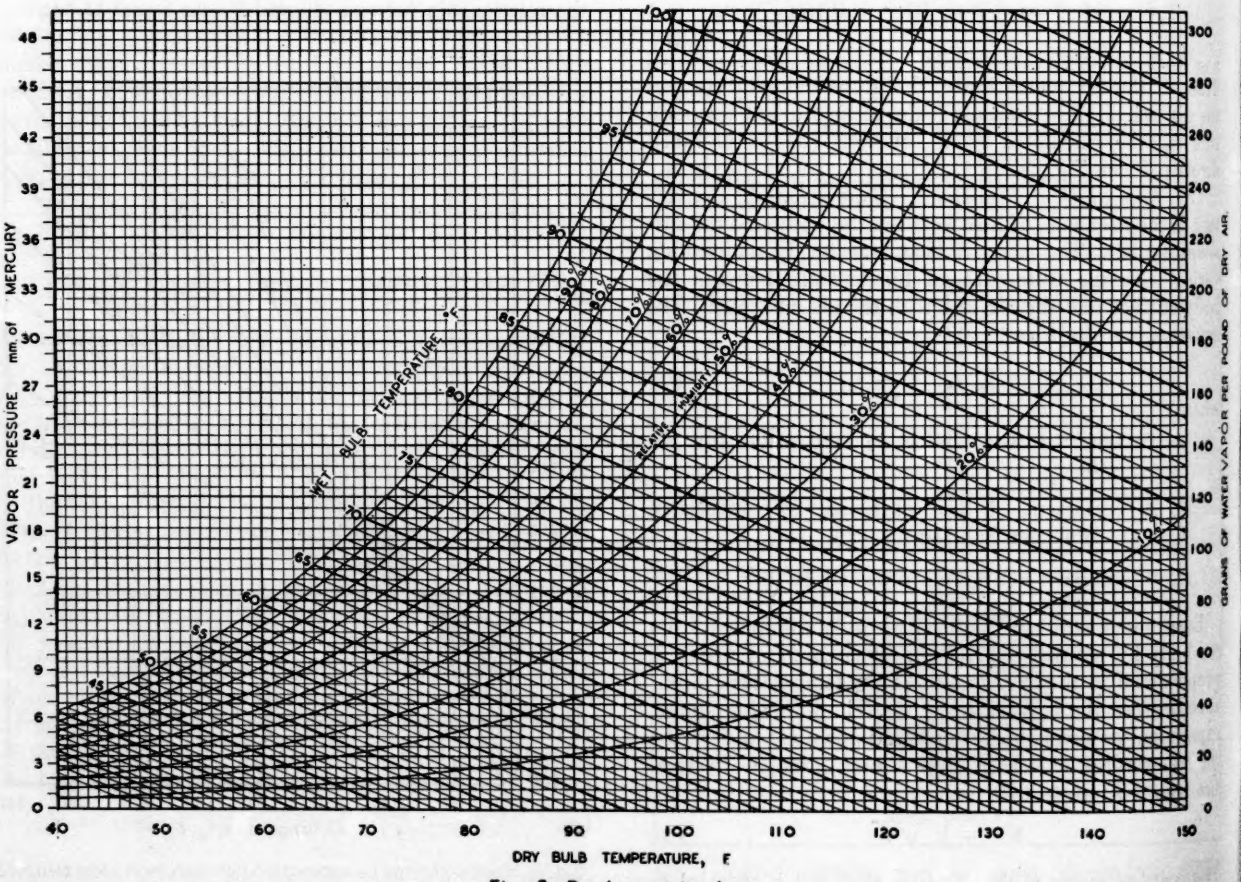

Fig. 8. Psychrometric chart.

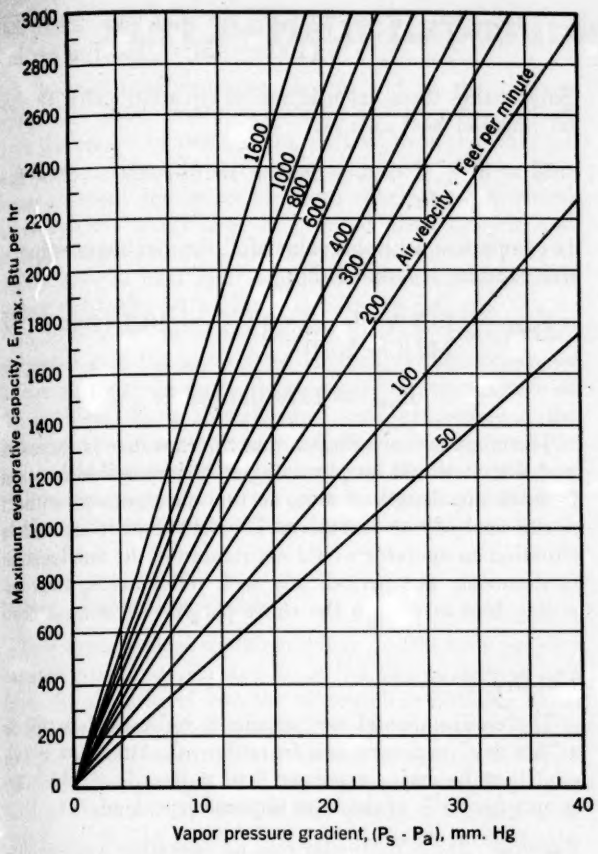

Fig. 9. Maximum evaporative capacity of man in relation to air velocity and vapor pressure gradient.

volves an *effective* velocity which recognizes all air movement rather than a specific directional velocity. In the hot-dry industries where relatively high convection velocities are encountered we have employed the Hastings air meter, for estimating air movement. This is a temperature-compensated hot wire anemometer which measures velocities up to 6000 fpm. It is not highly sensitive to direction, is rapid in response and convenient to use.

(6) *Rate of Heat Exchange by Evaporation, E.* Physically, the rate of evaporation from a wet surface varies with the area and shape of the surface, with the surface-air vapor pressure difference and with air velocity. The physical equations which have been developed are for surfaces which are completely and continuously wet—a situation which rarely occurs in the case of man.

A mathematical description of the human evaporative mechanism was developed by Gagge, who determined experimental values of K_e for sitting nude subjects in a moderately severe environment. Further data obtained at the Armored Medical Research Laboratory at Fort Knox on nude men standing in a linear horizontal air stream gave the following relationship between K_e and V for conditions of maximum evaporation:

$$K_e = 0.53\ V^{0.37} \qquad (V \text{ in fpm}) \qquad (13)$$

and

$$E_{max} = K_e\ A\ (P_s - P_a) \qquad (14)$$

or, substituting for K_e and A

$$E_{max} = 10.3\ V^{0.37}\ (P_s - P_a) \qquad (15)$$

where

E_{max} = maximum evaporative capacity when man is completely wet and at normal temperature, Btu per hr.

V = air velocity, fpm

A = body surface area ($A = 19.5$ sq ft for a completely wetted surface)

P_s = vapor pressure of water at t_s, mm. Hg

P_a = vapor pressure of moisture in the air at t_a, mm. Hg

K_e = coefficient of heat exchange by evaporation, Btu (per hr) (sq ft) (mm. Hg)

Assuming the skin to be completely wetted at 95F, the corresponding vapor pressure of water is 42.2 mm. Hg. The vapor pressure of the moisture in the air, P_a, can be obtained by multiplying the vapor pressure of water at the air temperature by the relative humidity or it may be read directly from the psychrometric chart, Fig. 8, and the maximum evaporative capacity can be calculated then from equation (15) or obtained graphically from Fig. 9.

The standard sling psychrometer or equivalent instrument is employed to give the dry and wet bulb temperatures from which the moisture content of the air and vapor pressure are determined. Here, again, the thermometers are affected by radiant heat and should be protected by shielding the bulbs. In most instances in the hot-dry industries there is no significant addition of moisture to the in-plant air. Hence, readings with the unshielded psychrometer taken in the outside air, free of radiant heat, may be used to calculate the water vapor pressure in the plant atmosphere.

Application of Heat-Balance Equation

In view of the practical insignificance of D and V as compared to M, the original heat balance equation (1) may now be simplified as follows:

$$M = \pm R \pm C + E \qquad (16)$$

Substituting equations (4) and (12) for R and C in equation (16) results in the following:

$$M = -15.5\,K_r\,(t_w - t_s) + 2.1\,\sqrt{V}\,(t_s - t_a) + E$$
$$\text{or } E = M + 15.5\,K_r\,(t_w - t_s) + 2.1\,\sqrt{V}\,(t_a - t_s) \qquad (17)$$

This is the required evaporation rate to maintain heat balance without a significant rise in body temperature. Clearly, it must not exceed the maximum evaporative capacity, as determined by equation (15), if heat balance is to be maintained under the conditions assumed. Its purpose is to provide a basis for comparison of evaporative needs with evaporative capacity and thus to evaluate the heat exposure in terms of the excess of one over the other.

This method of assessing heat exposures is typically an engineering procedure. Taken literally, it implies a precision of relationships between the physical stress factors of the environment and the physiological response of man to heat which may not be entirely acceptable to a student

of thermal physiology. Our reason for offering it is one of practical engineering. The only commitment we have made to physiological consideration is in the assumption that a worker who maintains thermal balance with the environment with an average skin temperature of 95F does not find the accompanying stress of serious consequence. The assumption was made only to provide a bench mark from which to calculate the excess of the need for evaporative cooling to maintain thermal balance over the actual maximum evaporative capacity.* This excess serves as a basis for comparison of the level of one heat exposure with another. Such comparisons are needed in the engineering analysis and design of measures for control of heat exposures to make certain that the resulting improvements will be accomplished in proportion to the needs.

Another practical reason for the separate calculations of *R*, *C* and *E* is that their relative importance is thus brought to attention and, as a consequence, control measures are properly selected in relation to the nature of the problem. In this respect, the method here outlined has an advantage over the comparison of hot exposures according to the effective temperature scale which, since it combines the four environmental factors in a single scale value, tends to obscure their respective contributions to the problem. This limitation applies also to the use of the globe temperature or the operative temperature which combine the radiant and air temperatures and the effect of air velocity but leave out of consideration the evaporative cooling capacity.

Examples

The following examples illustrate the application of this method of physical analysis to the evaluation of typical industrial heat exposures.

Example (1): An extreme heat exposure was encountered in the forming department of a glass plant. At a location most representative of a worker's daily exposure measured values of globe temperature, wet and dry bulb temperatures and air velocity were: $t_g = 130F$; $t_a = 100F$; $t_{wb} = 80F$; $V = 200$ fpm.

An average work rate equivalent to a metabolic heat production of 960 Btu per hr is assumed.

Determine:

(1) The relative contributions of radiation and convection to the total imposed heat load.
(2) The maximum evaporative capacity.

Solution: From equation (8)

$$T_w^4 \times 10^{-9} = T_g^4 \times 10^{-9} + .103 \sqrt{V}\,(t_g - t_a)$$

$$T_w^4 \times 10^{-9} = (590)^4 \times 10^{-9} + .103 \sqrt{200}(130-100)$$

$t_w = 177F$ = mean radiant temperature.

Assuming an average skin temperature, $t_s = 95F$, and referring to Fig. 2, $K_r = 1.47$. From Fig. 8, $P_s = 42.2$ mm. Hg and $P_a = 20.8$ mm. Hg.

The contributing effects of radiation and convection are:

(Eq. 4) $R = 15.5\ K_r\ (t_w - t_s) = 15.5\ (1.47)\ (177 - 95) = 1870$ Btu per hr

(Eq. 12) $C = 2.1 \sqrt{V}\ (t_a - t_s) = 2.1 \sqrt{200}\ (100 - 95) = 150$ Btu per hr

Substituting these calculations in equation (16), the total imposed heat load is:

$$E = M + R + C = 960 + 1870 + 150 = 2980 \text{ Btu per hr.}$$

In comparison with this value of *E*, the maximum evaporative capacity is found to be:

$$E_{max} = 10.3\ V^{0.37}\ (P_s - P_a) = 10.3\ (200)^{0.37} \times (42.2 - 20.8)$$

$$E_{max} = 1570 \text{ Btu per hr}$$

The comparison indicates that the exposure is excessive and that it would be physiologically impossible for man to work any length of time in this environment without a rise in body temperature. The fact is that in such a situation an operator would not remain in the one location continuously but periodically seek relief areas, thus enabling him to endure the short periods of intense heat.

Hot-Dry

The environmental measurements indicate that this is a "hot-dry" exposure and from the calculations it is evident that the major exposure is to radiant heat which accounts for 63% of the total imposed heat load.

Example (2): A particular mining operation was encountered in which the following environmental measurements were obtained: $t_g = 100F$; $t_a = 95F$; $t_{wb} = 90F$; $V = 200$ fpm. Assume an average skin temperature, $t_s = 95F$ and a metabolic heat production, $M = 960$ Btu per hr.

Determine:

(1) The contributing effects of radiation and convection.
(2) The maximum evaporative capacity.

Solution: From Fig. 5, $t_w = 110F$.

The contributing effects of radiation and convection are:

From Fig. 3; $R = 280$ Btu per hr.
Since $t_a = t_s$, $C = 0$ Btu per hr.

From equation (16) the total imposed heat load is:

$$E = M + R + C = 960 + 280 + 0 = 1240 \text{ Btu per hr.}$$

From Fig. 9, the maximum evaporative capacity is 545 Btu per hr.

Warm-Moist

The environmental measurements indicate that this is a warm-moist exposure and the calculations show that the heat imposed upon the body adds relatively little to the metabolic heat. Despite the low heat load, however, the exposure is extreme, because of the high moisture content of the air which, as illustrated by the calculated E_{max}, has seriously reduced the worker's ability to lose heat by evaporation.

*The maximum evaporative capacity assumes a completely wetted surface and neglects the hindrance to evaporation imposed by clothing.

Part 2—Heat Exposures in The Glass Industry

Industrial heat exposures are as old as the process equipment which produces the heat and from the earliest days the escape of this heat to working areas has created a problem of some concern. The magnitude of these heat losses in many industries has been either underestimated or completely overlooked in original plant designs and as a consequence, the plant engineer is frequently faced with a difficult heat control problem which he must solve within the limits set by building size, layout, etc.

In 1946 a review of the heat problems in glass plants* suggested that the methods of controlling heat exposures in common use do not fully recognize the true nature of the problem. Even though most heat exposures in the industry are not acute today, undesirable health, economic and psychological effects do result and the dissatisfaction with working conditions warrants a better understanding of the problem to developing improvements in control.

Nature of the Heat Problem

In a typical glass-container plant of 100 tons per day capacity, the heat leakage from the hot equipment and from the glass itself into the surrounding building space is of the order of 2 million Btu per minute. This is divided roughly among the various heat sources as shown in Table 2. The tank and forehearth account for about 85% of the total heat and, at first glance, one might think that these should receive first consideration in the analysis of the heat problem and design of control measures. The principal work locations, however, are on the forming floor and it is the 15% of the total heat given off by the forming machines and auxiliary equipment which determines, primarily, the levels of heat to which the workers are exposed.

In standard practice, primary dependence for heat control in glass plants is placed upon general ventilation obtained by gravity-operated roof ventilators with suitable side-wall openings as air inlets. The rate of ventilation so provided may amount to as much as 2 million cfm in the typical load shown in Table 2, resulting in a temperature rise of 50 degrees F as the air passes out through the factory roof. No such rise in air temperature can be tolerated by the workers especially in summer months, nor is such exposure contemplated. The objective is to introduce the cool outside air in such a way that it passes through the working zone before it is heated appreciably. It should then absorb heat as it rises by convection immediately around the hot equipment and, by virtue of its buoyancy, escape through the roof ventilator.

*Radiant Heat Studies in Glass Plants, by the Industrial Hygiene Foundation under sponsorship of Ball Brothers Co., Bartlett-Collins Co., Corning Glass Works, Hazel-Atlas Glass Co., and Owens-Illinois Glass Co.

TABLE 2—HEAT LOSSES IN A GLASS PLANT FORMING DEPARTMENT

Operation	Btu per hr	% of Total
Tanks	103,200,000	77
Forehearth	11,100,000	8
Glass heat loss (forehearth to lehr)	3,300,000	2.5
Auxiliary gas equipment, forming floor	8,200,000	6.0
Lehrs, glass plus re-heat	8,500,000	6.4
Incidental amount from mold ovens	190,000	0.1
Total	134,490,000	100

This objective fails in two respects: First, some of the incoming air is raised in temperature by contact with surfaces heated by radiation from primary sources before it reaches the workers. Second, there is the possibility of recirculation of heated air within the building resulting from the fact that the natural convection flow set up by the hot equipment is higher than the net building ventilation rate. To maintain the high rate of general ventilation, wall openings and the roof ventilators must be of large area. Thus, with 300 fpm inlet and outlet velocities, the area in each case must be around 6000 sq ft. There are difficulties in providing such extensive openings in the walls and especially to secure proper distribution of the incoming air in relation to the several heat sources and work locations. The problem is accentuated, as in many other industries, because too much production is often carried on in too little space and the enclosing building is rarely designed with the specific requirements in mind for introducing, distributing and removing such a large air volume per minute.

As a consequence of these limitations, the general ventilation is often reduced in effectiveness, especially in relatively confined areas around the forming machines and the workers are, in fact, subjected to substantially higher air temperatures than exist outside.

Added to these weaknesses in heat control by general ventilation is the more fundamental failure to recognize the fact that the greater fraction of the heat given off from the hot process equipment is transferred by radiation to surrounding surfaces and not by conduction to the air. This is shown by the following calculations:

Heat dissipation from hot surfaces occurs by convection to surrounding cooler air and by radiation to other surfaces at lower temperatures. The relative importance of each varies with the actual temperature levels and the degree of air movement. Assuming an average surface temperature for a glass tank or other process equipment of 500F, and 100F for surrounding air and walls, the coefficients of heat transfer by convection and radiation may be calculated as follows: Convection coefficient, $h_c = 0.3\ \Delta t^{1/4}$ for vertical walls $= 1.34$ ($\Delta t = 400$ degrees F) and for horizontal surfaces facing upward, $h_c = 0.38\ \Delta t^{1/4} = 1.7$. The radiation coefficient,

$$h_r = 1.7 \times 10^{-9} \frac{(T_1^4 - T_2^4)}{T_1 - T_2}$$

TABLE 3—CONTRIBUTIONS TO TOTAL HEAT LOAD DURING WINTER MONTHS

Test Location	Heat Exchanges, Btu per hr			Radiation % of Total
	Radiation	Convection	Total*	
A4	2175	−320	2815	77
A5	1925	−310	2575	75
B7	690	−115	1535	45
A10	2450	−280	3130	78
B9	780	−135	1605	49
C15	385	−445	900	43
C4	1900	−470	2390	79
C5	780	−440	1300	60
C2	600	−665	895	67
B6	780	−200	1540	51
B5	1900	−945	1915	99

*Includes an assumed body heat production rate of 960 Btu per hr.

TABLE 4—CONTRIBUTIONS TO TOTAL HEAT LOAD DURING SUMMER MONTHS

Test Location	Heat Exchanges, Btu per hr			Radiation % of Total
	Radiation	Convection	Total*	
A4	2270	280	3510	65
A5	1520	290	2770	55
B7	705	− 45	1620	44
A10	1750	110	2820	62
B9	985	140	2080	47
C15	525	−545	925	57
C4	1125	−145	1930	58
C5	865	−365	1450	60
C2	1080	− 95	1945	56
B6	770	−165	1545	50
B5	1465	−155	2270	65

*Includes an assumed body heat production rate of 960 Btu per hr.

where T_1 and T_2 are absolute temperatures of the tank and surrounding surfaces, respectively. This assumes perfect emission and the area of surrounding surfaces great compared with the hot surfaces. For a glass tank at 500 F, $h_r = 3.2$, which is approximately twice the convection coefficient. This calculation shows that two-thirds of the heat is lost by radiation and only one-third by convection. The radiant energy travels outward in straight lines until it strikes the cooler absorbing surfaces (walls, roof, structural members, machinery) which are heated and these in turn give up their heat to the air passing over them. Thus the heat is ultimately removed from the plant by ventilation but the points at which the air takes up the heat are widely distributed throughout the building rather than being concentrated at the original heat sources. The distribution of radiant heat is not markedly affected by air movement through the building nor does radiation heat the air itself.

The fact that two-thirds of the heat transfer is by radiation means that the mean radiant temperature of surroundings will be substantially higher than the air temperature and as a consequence the radiant heat load upon the workers will be greater than the convection load. Hence, in the design of heat control measures, first consideration should be given to the primary sources of radiant heat. This larger fraction of the total load, especially on the forming floor, must be prevented from escaping into the work spaces. It is not reduced by ventilation and the common practice of using man-cooling fans or air blasts to offset the radiant heat load on the workers is physiologically unsound. With air temperature above body surface temperature the increased air movement actually brings convected heat to the worker faster than in still air. Fortunately, his evaporative capacity increases to a greater degree so that there is a net benefit with respect to heat exchange. But it is accomplished by imposing a greater physiologic cost in terms of increased sweating. A better procedure obviously is to reduce the radiant heat load itself and thus minimize the need for extra air movement.

TABLE 5—RATIO OF THE REQUIRED EVAPORATIVE RATE, E, TO MAN'S EVAPORATIVE CAPACITY, E_{max} (Assuming no rise in body temperature)

Test Location	Ratio $\frac{E}{E_{max}}$	
	Winter	Summer
A4	1.97	2.58
A5	.80	1.43
B7	.75	.95
A10	1.54	1.81
B9	.81	1.14
C15	.39	.44
C4	.97	1.03
C5	.60	.77
C2	.36	1.43
B6	.84	.76
B5	.61	.99

TABLE 6—REDUCTION IN RADIATION BY SCREENING (single sheet of aluminum foil)

Test Location	Heat Exchange by Radiation, Btu per hr		% Reduction in Radiation
	Without Screening	With Screening	
D4	2600	900	65
D6	2240	775	65
D7	1440	500	65
D10	2450	1010	59
D12	1460	560	62
D15	1850	775	58
D16	3150	825	74
A11	3525	1275	64
A12	2000	980	51
A14	2670	820	69
A15	1850	800	57

Evaluation of Glass Plant Exposures

With the foregoing considerations in mind, an evaluation of heat exposures was undertaken with particular interest in separate measurements of the contributions by radiation and convection to the heat load. The method outlined in Part 1 was employed in the analysis of measurements obtained at various test locations representative of the workers' daily exposure. The following sets of data were obtained in each location.

(1) *Winter tests.* Environmental conditions are most favorable during the winter months and these tests were made to establish a baseline with which to compare levels of exposure during less favorable summer periods. Table 3 summarizes the winter test data obtained at 11 typical forming department locations where the heat problem is a matter of some concern. These results show the relative contributions of radiation and convection; radiation contributing 43 to 99% of the total heat imposed upon the body. According to the ratios in Table 5, two winter test locations were noted with extreme exposures in that the required evaporative rate exceeded the maximum evaporative capacity.

(2) *Summer tests.* Heat exposures are at their peak level during the hot-humid months and tests were made in identical locations as in the winter study for comparison purposes and also to determine the nature of these extreme heat exposures. Table 4 summarizes these measurements and calculations which show that radiation continues to be the major contributor to the extent of 44 to 65% of the total heat load imposed on the body. The radiation load is not affected materially by seasonal variation since the surface temperatures of the hot equipment are not particularly influenced by air temperature. Because of the higher air temperatures and air velocities during the summer months, however, convective heat is of more concern in summer. In addition to this and of even greater importance is the significant reduction in evaporative capacity during the summer because of the higher moisture content of the air. As the moisture content increases the evaporative capacity decreases until the skin surface is completely wetted and water just rolls off. When the evaporative rate is insufficient to accommodate the imposed heat load, then, the temperature of the body in-

creases until a new balance is reached at a level exceeding the temperature of normal body heat balance (98.6 F). If the heat exposure is so intense that body heat balance is incapable of being maintained, physiological stresses from discomfort to outright collapse may result. Table 5 shows that four locations with acceptable levels of heat exposure in winter changed during the summer to extreme exposures with the required evaporative rate exceeding the maximum evaporative capacity. This means that for continuous exposure these environments are excessively hot and incapable of being maintained without some physiological cost.

Experimental Heat Control Tests

Since radiation was by far the major heat contributor, preliminary studies were undertaken to determine the magnitude of improvement that could be effected by shielding. For experimental purposes it was impractical to investigate the value of insulation. Aluminum foil was used as the shield material because it is highly reflective, easy to handle and inexpensive. The experimental shields were made by tacking the foil onto light wooden frames, constructed in convenient sizes for placing between the test locations and the several major radiation sources. Particular care was taken in placing the shields so that they did not interfere with the men or the operation. Eleven locations were selected and measurements made in each location with and without the control shields in place.

Table 6 summarizes the results of these tests. By means of relatively simple shielding, a reduction of 50 to 75% in radiation load was effected. The magnitude of this accomplishment is best illustrated by comparing it with the amount of air cooling necessary to give the same improvement—something more than a 20-degree F drop in air temperature (example 3). One has only to reflect on the size and cost of refrigeration equipment to produce this degree of cooling and, in comparison, the simplicity of the shield, to realize the enormous practical value of heat control by radiation shielding.

Estimating Control Requirements

Since the heat balance equation, as developed in Part 1, involves all four environmental factors—air temperature, radiant temperature, moisture content and air velocity—it follows that an unbalanced thermal state can be restored to balance by changing one or another of these four factors. Employing the method of analysis described earlier,

Fig. 10. Aluminum siding segregates hot processes from adjacent areas at Corning Glass Works.

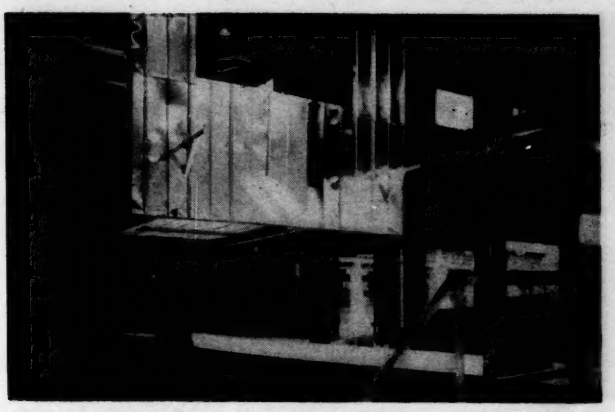

Fig. 11. Rolling mill pulpit shielded with aluminum siding at Bethlehem Steel Co.

one can calculate, for a typical heat exposure, how much change is required in each case.

Example 3: The following environmental measurements were made on a hot summer day in a location typical of a machine operator's exposure: Air temperature, t_a = 103F; wet bulb temperature, t_{wb} = 79.5F; air velocity, V = 300 fpm; globe temperature, t_g = 123F; outside air temperature = 87F.

Determine:

(1) The relative contributions of radiation, *R*, and convection, *C*.

(2) The required evaporative rate, *E*, and the maximum evaporative capacity, E_{max}.

(3) In order to bring about thermal balance by making the evaporative rate, *E*, equal the evaporative capacity, E_{max}, what is the required magnitude of change in each of the following:

(a) Radiation temperature,
(b) Air temperature,
(c) Air velocity,
(d) Moisture content?

Solution: (1) From Fig. 5 the mean radiant temperature, t_w = 162F. Assuming a skin surface temperature of 95F, then, from Fig. 2, K_r = 1.43. Substituting in equation (4), the heat imposed upon the body by radiation is:

$$R = 15.5\ (1.43)\ (162 - 95) = 1485 \text{ Btu per hr.}$$

From equation (12), the heat imposed upon the body by convection is:

$$C = 2.1\ \sqrt{300}\ (103 - 95) = 290 \text{ Btu per hr.}$$

(2) Assuming a metabolic heat production, *M*, equal to 960 Btu per hr, the required evaporative heat loss, *E*, is determined from equation (16):

$$E = M + R + C = 960 + 1485 + 290 = 2735 \text{ Btu per hr.}$$

R = 55% C = 11%

Assuming the skin to be completely wetted at 95F, the corresponding vapor pressure of water, P_s = 42.2 mm. Hg. The vapor pressure of the moisture in the air, P_a = 19.5 mm. Hg as obtained from Fig. 8. (Locate intersection of t_a = 103F and t_{wb} = 79.5F and obtain P_a = 19.5 mm. Hg on left hand vertical scale.)

From equation (15), then, the maximum evaporative capacity, E_{max}, for this exposure is:

$$E_{max} = 10.3\ (300)^{.37}\ (42.2 - 19.5) = 1930 \text{ Btu per hr.}$$

Fig. 12. Shielding with infrared reflecting glass on the hot side of a rolling mill pulpit at Bethlehem Steel Co.

(3) For the required evaporative rate, E, to equal the maximum evaporative capacity, E_{max}, a reduction in heat load of (2735 − 1930) or 805 Btu per hr is necessary.

(a) The reduction in radiation temperature to bring about the desired balance is obtained as follows:

$$(1485 - 805) = 15.5 \times 1.28\ (t_w - 95)$$

$$t_w = 129F$$

This means that the MRT must be reduced 162 − 129 = 33F.

(b) To achieve this same improvement by reducing the air temperature, the convective heat load, C, must be reduced to (290 − 805) or − 515 Btu per hr.

Substituting in equation (12):

$$-515 = 2.1\sqrt{300}\ (t_a - 95F)$$

or $t_a = 81F$ (a reduction of 22 degrees F in air temperature).

(c) The increase in air velocity necessary to bring about the desired balance is:

$$E_{max} = 10.3\ (V)^{.37}\ (42.2 - 19.5)$$

$$E = 960 + 1485 + 2.1\sqrt{V}\ (103 - 95)$$

Equating E and E_{max} and solving for V

$$V = 900\ fpm$$

(d) The reduction in humidity necessary to effect the desired improvement would be:

$$E_{max} = E = 2735 = 10.3\ (300)^{.37}\ (42.2 - P_a)$$

$P_a = 9.9$ mm. (this is equivalent to 19% relative humidity at 103F, a reduction of 18%).

These calculations are of practical value in the degree to which they illustrate the relative merits of various control measures. Thus, to meet the control requirements in the example, a 54% reduction in radiation is necessary. Experimental heat control tests by radiation shielding showed that 25 to 75% reduction in radiation could be effected by simple and relatively inexpensive shields. To achieve an equivalent improvement by ventilation requires a drop in air temperature of 22 degrees F. Outside air at 87F supplied directly to the working area without any heat pickup would lower the air temperature 16 degrees F which is 6 degrees short of the required reduction. Local man coolers installed to bathe the machine operators with air at 81F would need approximately 2 tons of refrigeration per 1000 cfm. Calculations show that thermal balance is obtained by simply increasing the air velocity to 900 fpm. However, such an abnormal air velocity is not desirable for, instead of the heat load being reduced, it will in fact be increased. The benefit comes only from the greater increase in evaporative capacity. This means that although body heat balance is maintained, abnormal quantities of water in the form of sweat will be lost by evaporation, which must then be compensated by an increased intake of salt and water. Likewise, the calculated 18% reduction in humidity necessary to effect the required improvement would merely enable the man to withstand the heat exposure at the expense of excessive evaporation losses. Moreover, the refrigeration needed to dry the air to 19% R.H. would be approximately 3 tons per 1000 cfm.

It is clear from these comparisons that radiation shielding is the method of first choice. It provides a direct attack upon the principal heat source and brings about an absolute reduction in heat load and is undoubtedly less costly per unit of heat control.

Radiation Shielding

Shielding is a primary method for reducing radiant heat exposures and the one method which has been largely neglected in industrial practice. It has the flexibility that insulation lacks in that it may be either fixed or movable, opaque or transparent. Various types of shields are described.

(1) *Opaque Shields*: (a) Reflecting type—made of highly reflective material such as aluminum, tin plate, nickel, and chromium. Excellent shields are made of aluminum foil backed by gypsum board; aluminum siding provides a more permanent form (Fig. 10 and 11).

(b) Absorbing type—made of heat-absorbing materials such as oxidized steel and iron or metals painted flat black. These surfaces absorb radiant heat and convert much of it into convected heat; the remainder is re-radiated at a lower temperature. Sheets of insulating material are even better.

(c) Exchanging type—made of iron or steel and water-cooled. The heat absorbed by the shield is removed from the area by the water.

(2) *Transparent Shields*: These are shields which absorb radiation such as chain and wire mesh or reflect radiation such as special types of infrared heat reflecting glass (Fig. 12).

Another method of protection from radiant heat which is really another form of shielding is in the use of *protective clothing*. This method has received little attention and, indeed, has been generally neglected. When radiant heat is prevalent, the body should be covered as much as possible with reflective, light-weight, loose-fitting clothing. For extreme exposures an aluminum-coated ventilated suit may be employed. Many cotton, duck and asbestos fabrics covered with aluminum are now available for just this application. This clothing reflects approximately 90% of the radiant heat and in no way hinders the man in his work. A worker having a high radiant heat exposure on an arm or leg, on the back, or some other particular area, can experience much relief by simply pasting aluminum foil on his clothing over this hot area.

It is to be emphasized that radiation shielding is the first line of attack on the problem discussed herein; however, it does not take the place of ventilation. In many instances industrial heat exposures cannot be adequately controlled by any one measure; hence a combination of radiant and convective heat control measures is necessary.

Reducing Return Line Corrosion by New Makeup Treatment

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A new approach to the problem of return line corrosion by reduction of makeup alkalinity through anion exchange is discussed in theory, and an example of practical application of the method is given.

A SUBSTANTIAL portion of the $6 billion annual cost of corrosion may be attributed to attack upon condensate return lines by dissolved carbon dioxide. The maintenance problems brought about by this form of corrosion are not only costly but require the use of materials in stringent supply. This problem has been investigated by a number of water treatment specialists (1) (2) and several solutions have been proffered.

The source of this carbon dioxide which distills off with the steam lies in the breakdown of bicarbonate and carbonate salts in the boiler salines as a result of heat and also through reactions with other water treatment chemicals. This condition is accentuated by sodium cycle zeolite softening of the makeup water which converts all alkalinity naturally present in the makeup water to the highly soluble bicarbonates and carbonates. Typical reactions illustrative of this breakdown follow:

(1) $NaHCO_3 + \text{Heat} = NaOH + CO_2$

(2) $Na_2CO_3 + H_2O + \text{Heat} = 2\ NaOH + CO_2$

(3) $3\ CaCO_3 + 2\ Na_2HPO_4 + H_2O = Ca_3\ (PO_4)_2 + 4\ NaOH + CO_2$

One fundamental solution to the problem of condensate return line corrosion lies in the reduction of the concentration of alkalinity in the feed water. An alternate approach consists of the feeding of palliatives such as amines of either the neutralizing type or the film forming type. Preliminary reduction of makeup water alkalinity content is desirable in the latter case to minimize the dosage of amines required for effective protection.

Alkalinity reduction in the makeup has heretofore been accomplished by any of the following means:

(a) Acid treatment
  (1) Direct addition of acid to water
  (2) Hydrogen zeolite
(b) Hot or cold lime treatment
  (1) Supplemented by hot zeolite softening
  (2) Supplemented by cold zeolite softening
(c) Hot or cold lime-soda treatment

Process (*a*) forms free carbon dioxide as a by product which must be eliminated by some form of degasification. Treatments (*b*) and (*c*) combine thermal removal of carbon dioxide with precipitation of CO_2 as a part of the insoluble calcium carbonate.

Research and development have made available a new ion exchange process designed for the reduction of dissolved alkalinity which is as simple as the familiar sodium cycle zeolite softener. This new process utilizes a highly basic anion exchange resin capable of regeneration with common salt.

Dealkalizing water by this process is achieved through contact of the water with a bed of Cochranex AP, a highly basic anion exchange resin; the reaction of the process is as follows:

$NaHCO_3$	+	A.Cl	=	A.HCO_3	+	NaCl
Sodium Bicarbonate		Chloride Form of Anion Resin		Bicarbonate Form of Anion Resin		Sodium Chloride

Additional reactions occur since the process is fundamentally one of anion exchange. Sulphates and nitrates present in the water are also exchanged for equivalent concentrations of chloride ion. These reactions are as shown below:

(4) Na_2SO_4	+	2A.Cl	=	$A_2.SO_4$	+	2 NaCl
Sodium Sulphate		Chloride Form of Anion Resin		Sulphate Form of Anion Resin		Sodium Chloride
(5) 2 $NaNO_3$	+	2A.Cl	=	2A.NO_3	+	2 NaCl
Sodium Nitrate		Chloride Form of Anion Resin		Nitrate Form of Anion Resin		Sodium Chloride

Before cleaning.

After cleaning.

Fig. 1. Sections of horizontal returns before and after cleaning. Note pitting of cleaned pipe.

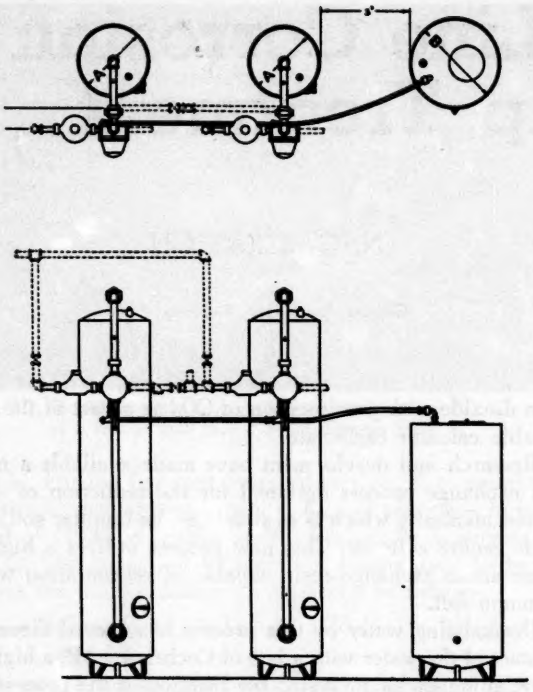

Fig. 2. Dealkalizer as installed at Reading Hospital.

The operating exchange capacity of the anion resin is exhausted when it is converted to the bicarbonate, sulphate and nitrate forms from the chloride form, necessitating regeneration. The regeneration process is a conventional one consisting of backwashing, regenerant introduction and rinsing. The regeneration reactions, forced by mass action, are tabulated below:

(6) $NaCl + A.HCO_3 = A.Cl + NaHCO_3$
(7) $2\ NaCl + A_2.SO4 = 2\ A.Cl + Na_2SO_4$
(8) $NaCl + A.NO_3 = A.Cl + NaNO_3$

The excess salt in the regenerant brine is rinsed to waste and the unit is ready to resume service.

Dealkalizing of boiler feed water by this new anion exchange process offers a number of advantages to boiler plant operators:

(1) Elimination of corrosion attributable to carbon dioxide released by breakdown of dissolved bicarbonates and carbonates.
(2) Elimination of carryover resulting from excessive alkalinities of boiler salines.
(3) No hazards resulting from handling concentrated and dilute acids.
(4) Corrosion resistant materials of construction are not required.
(5) No degasification equipment required.
(6) Regenerant (common salt) is cheap and readily available.
(7) Alkalinity reduction performed automatically and without the use of proportioning chemical feeders or blending control instruments.
(8) Operation can be conducted by unskilled labor employing a simple titrimetric test.
(9) Equipment is simple and compact.
(10) Double pumping is not required since dealkalization is accomplished under pressure.

Unfortunately the anion exchange is not specific for the bicarbonate and carbonate ions but includes the exchange of sulphate and nitrate ions; see reactions (4) and (5). This imposes an economic limitation on the process which becomes less attractive as the concentration of sulphates and nitrates rises in the influent water.

One modification of the process which has been mentioned (3) is of some interest. A single unit can be furnished with a bed of both sodium zeolite and the new anion resin. This single unit will simultaneously soften and dealkalize water, as shown:

(9) $Ca(HCO_3)_2 + Na_2Z + 2A.Cl = CaZ + 2A.HCO_3 + NaCl$

The two beds contained in the single unit can be simultaneously regenerated with a solution of common salt, NaCl, providing an advantage in salt economy.

(10) $2\ NaCl + CaZ + 2\ A.HCO_3 = Na_2Z + 2A.Cl + Ca(HCO_3)_2$

The water treatment unit which contains the two beds is subject to one inherent disadvantage in that the anion exchange material is very light and cannot be adequately cleaned by reverse flow backwashing if the raw water contains the slightest turbidity. A practical protective arrangement consists of the installation of a sodium cycle softener followed by a separate dealkalizer unit, thus minimizing the amount of suspended matter reaching the anion exchange resin. The brine utilized for regeneration of these units may be passed through them in series, regenerating the anion exchange bed and then the sodium cycle softener.

There is a considerable demand for softened water in many institutions for services other than boiler feeding such as laundry water supply. This softened water is most conveniently and economically furnished by a sodium cycle zeolite softener. The additional water softener capacity required for the boiler feed makeup is generally built into the institution softeners. A case which may be cited is that of the Reading Hospital of Reading, Pennsylvania, the pioneer plant installation of commercial dealkalizers.

The Reading Hospital is a large modern metropolitan type hospital comprising a physical plant of nine buildings which include three buildings of 450 hospital beds capacity. There are also two dormitories, power house, maintenance and garage buildings. Currently there is underway a construction program which includes the addition of hospital facilities of 200 additional beds, a food preparation building and additional dormitories which will ultimately house 350 persons. The existing condensate system represents a considerable investment which will be augmented as the physical plant is expanded. This condensate return system requires protection which is readily justified in view of the intrinsic value of the equipment, shortages of materials for maintenance and the necessity of uninterrupted service.

Originally, saturated steam for space heating, water heating, instrument sterilization, etc., was furnished by two boilers of 150 hp, operated at 120 lb per sq inch. Expansion of the physical plant necessitated increased steam generating facilities, and in 1948, Gilbert Associates, Inc., was retained to design and supervise installa-

TABLE I—OPERATING RESULTS SHEET
Reading Hospital, Reading, Pennsylvania

Constituent		Analysis in ppm as	PPM in Raw Water, Average Analysis	PPM in Sodium Zeolite Softener Effluent	PPM in NaZ Effluent after dealkalization
CATIONS					
Calcium	(Ca^{++})	$CaCO_3$	68	1	1
Magnesium	(Mg^{++})	$CaCO_3$	23	1	1
Sodium	(Na^{+})	$CaCO_3$	4	93	93
Hydrogen—FMA	(H^{+})	$CaCO_3$	0	0	0
Total Cations		$CaCO_3$	95	95	95
ANIONS					
Bicarbonate	(HCO_3^{-})	$CaCO_3$	61	61	5
Carbonate	(CO_3^{--})	$CaCO_3$	0	0	0
Hydroxide	(OH^{-})	$CaCO_3$	0	0	0
Sulfate	(SO_4^{-})	$CaCO_3$	23	23	0
Chloride	(Cl^{-})	$CaCO_3$	5	5	90
Nitrate	(NO_3^{-})	$CaCO_3$	6	6	0
Total Anions		$CaCO_3$	95	95	95
Total Hardness		$CaCO_3$	91	2	2
Methyl Orange Alkalinity		$CaCO_3$	61	61	5
Iron, Total		Fe	0.05	0	0
Carbon Dioxide, Free		CO_2	1.6	1.6	1.6
Silica		SiO_2	5.5	5.5	5.5
Turbidity			0.1	0	0
Total Dissolved Solids			127	..	..
pH			8.0	8.0	6.7
CO_2 in steam calculated with 20% makeup			..	10 to 15	1.0 to 2.0

tion of a new boiler. The new steam generating unit selected was a Combustion Engineering Superheater, Inc. boiler, designed to produce 18,000 lb per hr of steam at 150 lb per sq inch with 50 degrees superheat. Shortly after this boiler was placed in operation, steam service to the new "M" building was inaugurated. This building is operated as a combined nurses home and a patient area. Heating steam is distributed throughout this building at 8 lb per sq inch and the condensate returned under this pressure to the boiler plant. A vacuum return system is employed to recover the condensate from the other hospital buildings. Condensate return piping is concealed above ceilings and within walls. Corrosion appeared early in the condensate system of "M" building and the ferrous metal corroded from parts of the system was deposited as oxide in the horizontal runs of the return piping; this deposition occurred to such an extent that 40% of the cross-sectional area of some of the pipes was lost through deposits. Reference to Fig. 1 reveals the deposits to be uniformly concentric with the inner pipe walls. A small amount of pitting had occurred but in the areas of deposition the attacked metal was insufficient to account for the quantity of oxide deposited.

The treatment of the boiler feed makeup water for a number of years had consisted of sodium zeolite cycle softening of Reading City water. Boiler feed water, consisting of a mixture of makeup and condensate return was passed through an open heater and subsequently treated with sodium sulphite, a substantial residual of which was maintained in the boiler salines. These facts coupled with the operation of a 5 to 10 lb per sq inch pressure heating system in Building "M" and the well known breakdown of sodium bicarbonate and sodium carbonate to liberate carbon dioxide led interested parties to suspect carbon dioxide to be the corrosion agent.

Even though the raw water alkalinity is relatively low, in the range of about 40 to 80 ppm as $CaCO_3$, and the percentage of makeup to the boilers supplying heating steam for the institution and the laundry is conservative, approximately 20%, return line corrosion became a costly problem. After operating for five years with zeolite softened water for makeup, the annual maintenance cost for replacing condensate return lines was found to be exorbitant, amounting to as much as $2000 a year.

Consideration was given to various means of correcting the problem of return line corrosion, including the feeding of amines and the use of hydrogen zeolite. Fortunately, the new process of dealkalizing by anion exchange had, at the time this problem demanded a solution, just passed the laboratory development stage, Gilbert Associates recommended that the client install this new process to solve their difficulties. The recommendation was based on the advantages of simplicity and availability of cheap salt which favored this new process.

The new dealkalizer at the Reading Hospital is illustrated in Fig. 2, and its similarity to a simple sodium zeolite softener is readily apparent. Table I indicates the raw water analysis, the analysis of the water discharged from the sodium zeolite softener, and the analysis of the final effluent as delivered from the dealkalizing system. CO_2 in the steam based on 20% makeup is included.

Cost of treatment using 2.4 lb of salt per thousand gallons for softening and 2.6 lb per thousand gallons for dealkalizing would be five cents per thousand gallons treated with salt at one cent per pound. An arrangement could dealkalize and soften with the same salt.

The equipment, having a capacity of 18 gpm, was purchased and installed at a total cost of approximately $4500. Amberlite anion resin manufactured by Rohm & Haas Co. was used in the exchangers.

This system has operated at Reading Hospital since November 1951 and in that time the CO_2 in the steam has been reduced to the desired amounts.

Prior to dealkalization, the condensate contained an average of 15 ppm CO_2 and had a pH of about 5.5. Since installing the dealkalizing system, CO_2 in the condensate has been reduced to less than 2 ppm and the pH of the condensate has been increased to approximately 6.8. Thus about 90% of the condensate CO_2 has been removed.

Development of the dealkalization process by Cochrane Corp. and recognition of its applicability to the Reading Hospital corrosion problem by Gilbert Associates combined in a simple solution which is both practical and free of the operational problems which would attend the application of older, more conventional processes.

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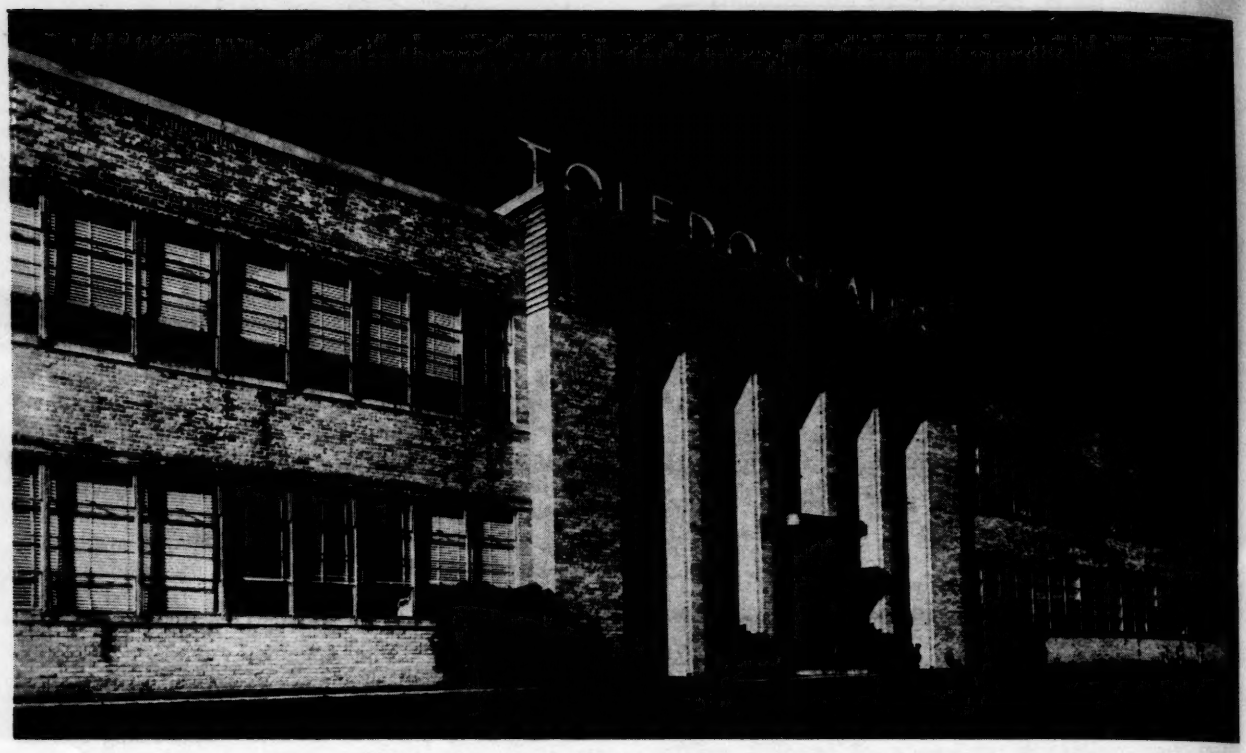

Fig. 1. General office building of the Toledo Scale Co.

Comfort Air Conditioning System Emphasizes Dehumidification

W. A. FINK

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In 1941 and again in 1946, Toledo Scale installed chemical absorbent-type humidity conditioning systems to provide for personnel comfort in, first, its general offices, and then its engineering offices. Today these two systems continue to eliminate oppressive summertime working conditions.

ELEVEN years ago, management of Toledo Scale Co. recognized a need for summer air conditioning and decided to do something about it. They acted on a program to determine just what was desired in an air conditioning system, to investigate thoroughly equipment to attain these results, and to purchase that which would most economically meet specifications.

Toledo Scale's purpose was to air condition its general offices (see Fig. 1). Company engineers made a careful study of the factors which affect comfortable working conditions. Their subsequent report emphasized that excessive humidity in an office space is as detrimental to favorable work output as is high temperature. The decision was made to select equipment which could adequately control both temperature and humidity.

Engineers pointed out that a temperature of 78F and a relative humidity of 45% are considered within the range of ideal summer comfort conditions. The next step was to determine what equipment and which air conditioning system would best fit requirements at Toledo.

During an investigation of existing installations, a high percentage of comfort air conditioning systems was found which either completely neglected the humidity problem or offered such little dehumidifying as was incidentally obtained when cooling air to approximately 65 to 70F. Air cooled to within this range was then delivered to the room in question to maintain a dry bulb temperature of 80F. Invariably, the relative humidity was well above 50%.

Generally, these systems utilized refrigeration equipment only. It is possible to obtain a relative humidity of 45% or less with this type system. On the other hand, to do so involves cooling the air to a very low temperature in order to condense out moisture. This chilled air is then reheated to the required air delivery temperature. To cool the air to the delivery temperature only would require a great deal less refrigeration tonnage, fewer horsepower, and smaller steam requirements.

Fig. 2. A portion of the general office.

Unpleasant sensations of thermal shock, chill, and clamminess may be encountered upon entering, leaving, or working in an office where the atmosphere is cooled but not properly conditioned with respect to humidity. These reactions result from two conditions: (1) pores of the body are wide open, skin temperature is high, and surface blood circulation accelerated when one passes from the hot outdoors into a cool air-conditioned building; and (2) indoor and outdoor air may have a moderate temperature difference in the summertime but contain like amounts of moisture. Hence the ability of the indoor air to evaporate perspiration may be considerably less. The first condition causes a sudden shock on the human system; the second results in the familiar clammy feeling.

This last can be explained by noting that the human body is its own evaporative cooler. The hotter and drier the air the more direct body moisture evaporation occurs. Consequently, a greater evaporative cooling action takes place and a balance is struck between body heat production and gains or losses by convection and radiation. It is this cooling action which permits body comfort at a temperature of 78F, if the relative humidity is sufciently low, e. g., 45%.

In many systems examined in 1941, the air to be circulated was directly in contact with wet coils. It was assumed that a maintenance problem in eliminating collected dirt on wet coils would be of paramount importance in obtaining a quality air conditioning installation. Dry coils, it was thought, would provide less opportunity for bacterial growth and perhaps reduce the causes for ill health in the office.

Toledo Scale, from this investigation, set up its requirements: (1) the air conditioned office, pictured in Fig. 2, must be maintained at 78F and 45% R.H. at all times during the range of normal summertime outdoor conditions of 85F and 70% R.H. to 95F and 40% R.H.; (2) the circulated air must contact only dry coils prior to delivery to the rooms; and (3) the air distribution system must be of the draftless type, for obvious reasons.

Humidity Conditioning System Installed

Based on these requirements, Toledo engineers considered dehumidfying systems with cooling of the air a secondary factor. The equipment finally selected in 1941 was a Kathabar humidity conditioner, of 4000 cfm capacity, manufactured by Surface Combustion Corp. of Toledo, Ohio.

This equipment uses water-absorbing solution of lithium chloride to take moisture from the air. All outside air, 4000 cfm, is passed through the air washer cell of this equipment to contact a spray of the absorbent. Here moisture in the air is reduced to a specified amount so as to maintain the office spaces at 45% R.H. at all times.

Both air and absorbing contact cooling coils during the dehumidifying action in the cell, for the absorbing solution becomes more hygroscopic as its temperature is lowered. A maximum of 30 gpm of 53F well water is circulated in the coils to control the absorbent temperature.

Once the temperature of the cooling medium has been decided, rate of flow of the coolant determines how much dehumidifying occurs. As the entering fresh air conditions change, this rate of flow varies automatically to effect the proper amount of dehumidification. For the Toledo Scale system, 266 gallons of water per day is wrung from the air under maximum operating conditions.

Well Water for Cooling

Air is cooled both before entering and after leaving the dehumidifier. Toledo Scale drilled a 550-ft well to obtain a source of cheap cooling water especially for its air conditioning system, feeling that reduced utility costs over a period of years would more than offset this major expense item. Therefore, it has been deemed economical to use 72 gpm of this 53F well water for precooling the air to reduce the dehumidifying load, and 95 gpm for aftercooling to obtain the desired delivery air temperatures.

The dew point of the air upon leaving the dehumidifier is lower than the temperature of this cooling water, due to the moisture removal action. Hence, no moisture condenses out on the aftercooling coils. Although some water vapor does condense in the precooler, the air contacting these coils is not directly circulated to the offices, but must first pass through the dehumidifier and the aftercooler.

Regeneration of the absorbing solution is automatic. After completing the dehumidifying pass, the moisture-laden absorbent passes over low pressure steam pipes in a separate regenerator chamber of the system. This piece of equipment is illustrated in Fig. 3. Here, under maximum operating conditions, 256 lbs per hr of steam vaporizes the excess moisture. A scavenger air stream

Fig. 3. Regenerator unit of the humidity conditioning system. Here low pressure steam vaporizes out of the absorbing solution a maximum of 266 gallons of water per day.

carries the vapor outdoors, while the absorbent, now at full strength, returns to the air washer cell.

Once started up, the system operates on a continuous and automatic basis. All requirements originally set forth by Toledo Scale engineers were met. An adequate supply of fresh air allows for no stuffy office feeling, and chill, shock, and clamminess have not been encountered.

Second Humidity Conditioner Installed

So satisfactory was this air conditioning system that, in 1946, Toledo Scale installed a second system to provide an identical atmosphere for its newly-built engineering offices and all factory offices. For this plant extension, on the opposite side of the factory from the general offices, there is a 5000 cfm capacity Kathabar humidity conditioner, again handling all outside air. This dehumidifier is of the package unit type, in that the air washer and regenerator chambers are mounted on the same base. Operation of this latest line, with separate cooling and dehumidifying, is similar to the 1941 installation.

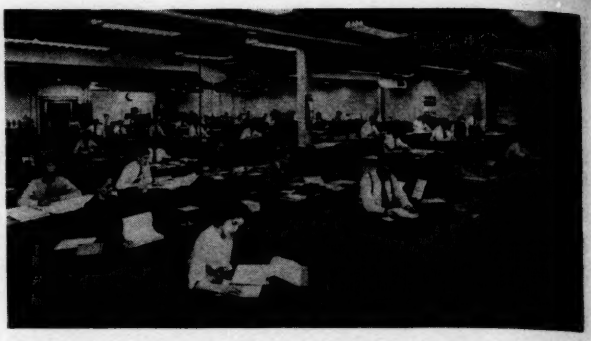


Fig. 4. Main engineering office.

Fig. 4 is a view of the main engineering office which this line serves. Here draftsmen, designing new models for a precise weight measurement line of equipment, are no longer victims of excessive humidity, with summertime letdowns due to oppressive working conditions and soiled drawings from perspiration marks. For Toledo Scale, these problems are a thing of the past.

Calibrated Draft Regulators

Proposals are made now and then that all draft controls have markings or calibrations so that they may be adjusted without the aid of draft gages.

Many draft regulators for space heaters are produced which are accurately balanced so that drafts varying from a low draft of .02 inch, a medium of .04 inch, and a high of .06 inch can be obtained readily without using draft gages. Other ranges of setting also are available. However, such controls must be installed in certain definite relations to the heaters, or the results will be unsatisfactory.

In addition, Underwriters' Laboratories now requires that each draft control bearing their approval must maintain a minimum draft of .02 inch.

One manufacturer pre-sets the controls at the factory so that drafts of .06 inch will be obtained (measured in the flue pipe adjacent to the control). This setting can be changed easily by the installer, as required for the most efficient operation of the plant, but should he fail to set the control, the factory setting will provide fairly satisfactory results until a more careful check of the furnace is made. With hand fired coal burning furnaces, a setting of .06 inch usually is about the best for all around performance. Often no change in the draft control setting is required for such cases.

The big question is whether it is wise to mark or calibrate all controls to indicate the drafts being maintained. To sell readily, most draft controls must be designed so that they can be used on a great variety of heating units made by many manufacturers. It must be possible to take a draft control off of the shelf of any jobber or dealer and install it with confidence that it will work properly.

The more important objection to calibrating all controls is that no two furnaces or boilers are identical in construction. The correct setting for the draft regulator must be the one that provides the proper draft over the fire, regardless of that which is observed in the flu pipe. If the firing rate of the burner is changed materially, a change in the draft control may be necessary, too. Usually CO_2 and flue temperature readings are taken when adjusting an oil burner, and the over fire draft set at the minimum which will just carry away the flue products. Drafts in excess of this will waste fuel.

If the installer should be instructed to set each draft control at some particular calibration mark, each control must be installed in the same relation to the smoke outlet of the furnace, as for instance, always as part of a horizontal flue, at a fixed distance from the furnace, with no elbows between. Or perhaps it always must form a part of a vertical run of pipe, being located the same distance above the floor. Unless this uniformity of installation is mandatory, the over fire draft with one furnace will differ considerably from that of another of the same construction, even though both draft controls have the same settings. The variations in drafts maintained will not be insignificant, either.

Draft readings taken at different points in a flue or smoke pipe vary considerably also, especially in the proximity of elbows. At its best, a calibrated draft regulator can maintain the draft indicated by the position of the weight only at a point in the flue closely adjacent to the regulator. And unless the weight of a control is adjusted to a different position for a vertical pipe installation, as compared to a horizontal pipe installation, a draft reading taken in a vertical flue pipe below the draft control will be greater than that found in a horizontal pipe, at the same distance from the regulator.

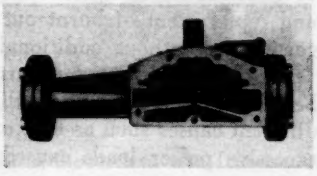
To sum up the matter, all controls could be calibrated, but it is much safer to adjust the control by using combustion testing apparatus, checking for CO_2, flue temperature, smoke and draft.—E. A. FIELD, Field Control Division, H. D. Conkey Co., Mendota, Ill.

NEWS OF EQUIPMENT AND MATERIALS

Use the prepaid postcard opposite page 137 for securing additional information on items described in this department.

Proportion Gas to Heat Load

Changing heating loads on combustion equipment is now simplified by the new Vari-Set mixer, introduced by the Eclipse Fuel Engineering Co., Rockford, Ill. A built-in, adjustable orifice eliminates replaceable jets, and changes volume of automatically proportioned gas and air for any heat output within the capacity of various sized mixers used in furnaces, ovens, kilns, and other combustion equipment.



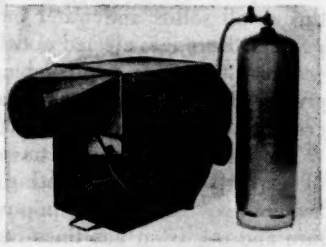
Gas entrained by the air stream is automatically proportioned to form a mixture that gives perfect combustion at all heating loads. A metering valve regulates the pressure for operating control equipment and for burning mixed, natural or L. P. gas.

Advantages can be seen in many industries where heating equipment is operated in series or in parallel. In parallel hook-ups, equipment may be operated under varying loads with this one type of mixer, and any unit may be changed quickly and easily without dismantling pipes, burners, mixers and other equipment. Unproductive downtime is eliminated. For units operated in series, individual burners may be adjusted without changing the output of the other units.

More information? Circle Item 1 on postcard, page 137

L. P. Portable Heater, Dryer

The Chinook Wind portable heater and crop dryer, using propane or butane gas, used for winter construction jobs, for inside work such as plastering, for farming, ranching, airports and many other fields, is announced by International Mfg. Co., Denver, Colo.



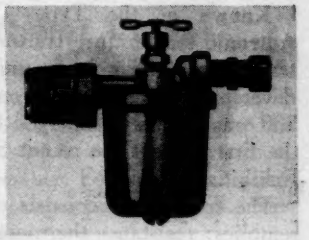
It is 2 feet wide, 3 feet high and 4 feet deep, outside measurements, and weights 150 pounds. It can be moved by one man, utilizing its rubber-tired, semi-pneumatic, ball-bearing wheels. The heating unit is a cast iron torch with a motor driven fan, delivering 3,500 cfm of 250 deg. air, a heat capacity of 500,000 Btu per hour.

A smaller model, the Little Chinook, with a capacity of 100,000 Btu per hour is 18 inches wide, 23 inches high and 11 inches deep, and weighs 35 pounds. It is especially useful to floor-tile installation men.

More information? Circle Item 2 on postcard, page 137

Fuel Oil Filter and Shutoff

A ceramic filtering element and a non-breakable transparent plastic bowl are features of the Sette heating oil filter manufactured by Marquart Mfg. Co., Oakland, Calif. It combines a shutoff valve, filter, 3/4 inch tank fitting, and 3/8 inch outlet tube fitting in one assembly. It is designed for use with home heating or light industrial oil burner installations, and is said to remove harmful dust, scale, and water, eliminating need for frequent burner service.



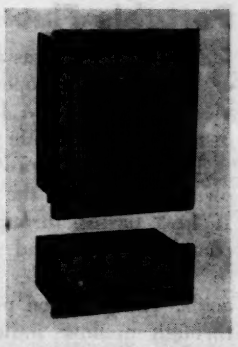
The ceramic element is easily cleaned, lasts indefinitely or may be quickly replaced at low cost. The removable transparent bowl is of a plastic which the manufacturer claims is not affected by normal heat, cold, or petroleum products, and features a safety factor of non-breakability.

Integral with the filter body is a 3/4 inch fitting permitting the unit to be installed directly in the fuel tank or drum. A shutoff cock is built into the intake passage, eliminating need for separate valve installation. The 1/4 inch threaded outlet comes complete with 3/8 inch fitting.

More information? Circle Item 3 on postcard, page 137

Automatic Oxygen Analyzer

The Model F-3 is an addition to the line of oxygen analyzers manufactured by Arnold O. Beckman, Inc., South Pasadena, Calif. Designed for combustion applications in power plants, the instrument indicates the oxygen content of flue or process gas automatically. Thus, with more accurate combustion control, substantial savings in fuel costs can be effected.



Oxygen is unique among gases in that it is strongly paramagnetic—attracted into a magnetic field. This device measures this magnetic susceptibility by means of a simple physical principle without recourse to chemicals, filaments, fuels, wicks, or other mechanical aids. The principle is so positive that it provides oxygen measurements of high accuracy.

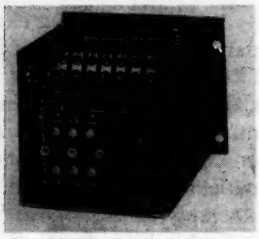
The device is unaffected by gases other than oxygen. Accuracy is within 1% of full scale for spans of 5% and greater. Combustion ranges include 0-5%, 0-10%, 0-15%, and are supplied with a second range of 25%. Other ranges to 0-100% are available. A positive check of proper operation is made by simply recording the air-point on the second range.

Any standard potentiometer recorder, controller, or pneumatic receiver can be used with the instrument.

More information? Circle Item 4 on postcard, page 137

Temperature Transmitter

A new temperature transmitter for use in chemical and food processing plants, refineries, petrochemical plants, and central stations is announced by The Swartwout Co., Cleveland, Ohio. The unit has been designed primarily for use with the all-electronic Autronic control system.



Known as the Type T2T Autronic temperature transmitter, the unit has been under development for several years and was publicly displayed for the first time at the recent Seventh National Instrument Exhibit.

The transmitter consists essentially of two major assemblies: resistance thermometer element and thermometer adapter unit (illustrated).

The thermometer element is made of pure platinum wire wound on a ceramic core and sealed in an Inconel tube. Standard thermowell, lagging extension thermowell, or finned thermowell styles are available.

The thermometer adapter unit converts resistance changes in the thermometer element to a proportional signal voltage which varies from 0.000 volts to 0.500 volts 60-cycle a-c for the full range of the measuring element. The thermometer element is connected to adapter unit by a three-wire system that compensates for variations in lead wire resistance with ambient temperature change. A special adjustment is provided in the adapter unit to compensate for minor variations in thermometer element resistance. Each thermometer element is factory calibrated and compensator setting for thermometer adapter is determined and stamped on the thermometer name plate.

More information? Circle Item 5 on postcard, page 137

Portable Flue Gas Analyzer

A portable flue gas analyzer for small boilers and heaters has been developed by Instrument Engineering Service, Michigan City, Ind. It gives a continuous reading of the carbon dioxide concentration.

The analyzer draws its own sample from the flue. It first passes through a condensate trap and filter to remove particles and acids. The gas then passes through a flow indicator and from there moves into the pump. The sample then travels into a thermal conductivity cell where the CO_2 content is detected and indicated on a meter on the face of the instrument.

This instrument is used for checking the efficiency in small boilers and heaters. Due to the continuous operation, it makes a convenient tool for research studies on flue systems and boilers.

The instrument normally is calibrated 0-20% CO_2, but special models have been built for readings as low as 0-5% full scale. The normal instrument is accurate to ¼% CO_2. The readings will change within five seconds after a change has occurred in the flue, and the complete reading will have taken place within 20 seconds.

The instrument measures approximately 10 x 10 x 10 inches and weighs 12 pounds. There are no chemicals to replace. The maintenance and upkeep are negligible.

More information? Circle Item 6 on postcard, page 137

Blower Coil Motor Protector

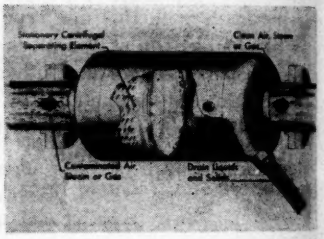
Fan motors on all Recold blower coils now have a built-in overload protector which will prevent motor burn outs, according to Refrigeration Engineering, Inc., Los Angeles, Calif. This change brings a saving to users of these blower coils, from the standpoint of service calls and replacement of burnt out motors, and has been incorporated without additional cost.

The problem of motor burn-outs on blower coils has been critical because the trouble can result from so many different causes such as lack of oil, mechanical abuse, or excessive power loads caused by circuiting conditions.

More information? Circle Item 7 on postcard, page 137

Gas Purifier Is Improved

An improved line type Hi-eF purifier with a more simplified design, which performs automatically and without any moving parts or baffle plates, yet removes more than 99% of dirt, oil, and moisture even at extreme velocities and pressures, is announced by V. D. Anderson Co., Cleveland, Ohio. It removes the entrainment through a stationary centrifugal separating element. The purifier is adaptable for steam, air, gas, and vapor lines in all types of industry.



The entrainment laden vapor entering the purifier is engaged by the new element which imparts a controlled but rapid rotational motion to the vapor. This action throws all solids and water outward to the walls of the purifier. Here it is ejected out the drain. The entire action occurs without any appreciable drop in pressure, and the greater the velocity through the unit the higher the separating efficiency.

The unit can be applied to clean up steam from boilers so as to protect reciprocating engines, turbines, superheater tubes and other equipment. It will remove moisture and oil, from gas lines between and after compressor stages. The purifier protects steam ejectors, valves and other expensive pipeline equipment, and it removes entrainment in exhaust steam and vapor applications. The unit can clean up exhaust steam for further use.

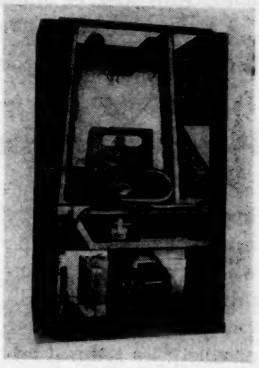
This line type purifier is made in all standard sizes up to 24 inches for pressures up to 600 psig. All units have forged steel flanges with borders of welded steel construction.

Bulletin 200 is available.

More information? Circle Item 8 on postcard, page 137

Packaged Unit Heats and Cools

A complete year-round air conditioning unit, the Weathermaker, designed specifically for the $10,000 and up mass home market is introduced by Carrier Corp., Syracuse, N. Y. The company claims that this unit will cost only $700 to $800 more than a forced air heating system installed. It is said to be the only unit providing two tons of cooling and dehumidifying capacity plus winter heating in a single closet-size cabinet.



The new unit will handle the year-round cooling and heating job in the average low-priced, three bedroom home in any area of the country. It only requires about three feet by three feet of floor space, and it stands little more than five feet high. The new unit is entirely sound-proofed and heat-proofed. It can be placed in a small closet in the middle of the house, saving on duct work, or in the cellar, garage or even attic.

New features include heating with any type of gas, or with oil. For those sections of the country where water is in short supply or is expensive the unit is available with air-cooled refrigerant condensing which does away with the need for water or for a cooling tower. It cools the home and removes excess humidity in the summer, heats it in the winter and provides year-round circulation of fresh, clean, filtered air. Both heating and cooling are controlled by a switch on the unit or from a separate thermostatic control anywhere in the house.

All sections of the unit can be reached from the front, by the simple removal of a panel. Air enters the unit from either the side, back or bottom and can be distributed through the house in any of four directions. This provides flexibility of installation.

More information? Circle Item 9 on postcard, page 137

Pocket Size Volt-Ammeter

The Amprobe 300, a pocket-size volt-ammeter with nine ranges up to 300 amps and 600 volts, has been introduced by Pyramid Instrument Corp., Lynbrook, N. Y. The instrument is of the snap-around type, which enables the user to measure current instantly without shutting down equipment or making ammeter connections.

Voltage test leads are equipped with a new retractible safety plug which automatically insulates itself when removed from meter. Jaws are completely insulated down into the sockets, protecting against shorts and shocks. Probe jaws are pointed for working in crowded switch and terminal boxes. No-rim window floods scale with unobstructed light from the sides. The instrument is pocket-size and belt-mounting.

Some of its uses include: determining load conditions, checking motor overloads, balancing loads, locating grounds, tracing shorts, checking open windings in motors and checking voltage losses.

Price is $49.50, complete with cowhide leather case and voltage test leads.

More information? Circle Item 10 on postcard, page 137

Combined T & P Relief Valves

A new line of temperature and pressure relief valves, for use on hot water tanks and heaters, is announced by McDonnell & Miller, Inc., Chicago, Ill. Known as the 202 Series, these valves are actually a combination of two time-tested valves in one assembly. For guarding against both excessive pressure and temperature, they offer savings in cost and installation time. These new combination valves are of the automatic reseating type, and are Btu-rated for proper selection.

For pressure relief the valves utilize the operating mechanism of the 230 Series valves developed recently to provide accuracy of operation at moderate cost. The pressure relieving capacities of the 202 Series are steam rated, since this represents the only feasible way to match discharge capacity of the valve to the Btu output of the heater to prevent over pressure under any emergency, such as failure of the water supply, that could permit a steaming condition.

For temperature relief the valves utilize the operating mechanism of the No. 201 development which combines accurate response to temperature variation, powerful and positive opening, and full automatic reseating when temperature is under control. It features an adaptation of the time-proved Vernatherm element, developed through extensive research to obtain ideal characteristics for use in such a valve. It starts to open when water surrounding the element reaches 188 deg; opens rapidly to full capacity at 208 deg; permits drip-tight reseating when temperature drops to 183 deg. The temperature relieving capacity is Btu-rated in terms of hot water discharge.

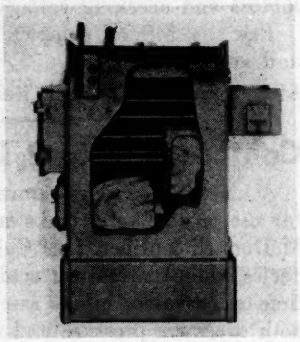
An important innovation is the fixture connection, a ¾ inch tapped opening which permits taking the service water flow directly through the body of the valve. Besides simplifying piping hook-up considerably, this arrangement also eliminates any accumulation of air in valve chamber and keeps the thermostatic element subjected to the temperature of the service water to eliminate any so-called temperature lag.

The valves are available with standard opening pressure settings of 75, 100, or 125 lb. Catalog numbers, and pressure relieving capacities, are: 202-75, 410,000 Btu per hr; 202-100, 527,000 Btu per hr; and 202-125 644,000 Btu per hr. Temperature relieving capacities for all valves, regardless of opening pressure, is 725,000 Btu per hr.

More information? Circle Item 11 on postcard, page 137

Boiler Water Line Lowered

Relocation of the water line of its R-Z-U Junior steel boiler, to make it as low as is possible commensurate with rated boiler capacity, is one of the improvements made in this boiler by its maker, Fitzgibbons Boiler Co., Inc., New York, N. Y. The boiler re-design retains all the former efficiency features, including a firebox of ample volume, strong, positive water circulation, certified flange quality steel construction, and hydrostatically tested to 60 lb before shipment.



Easier installation and servicing is another feature of the improved boiler. It is compact and needs little free space on either side. It can be placed close against a rear wall as the clean-out door for the smoke box is located on the side. All other cleaning is done from the front. Controls are located for in-line installation near the boiler front. The boiler can be supplied for burning oil, gas, anthracite or bituminous coal, stoker or hand-fired.

Bulletin JR-10-1 is available.

More information? Circle Item 12 on postcard, page 137

Adsorbent Dehumidifier

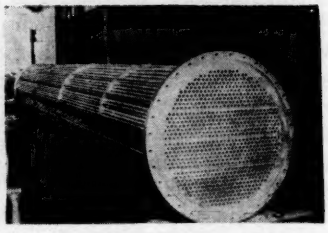
A new adsorbent type fully automatic dehumidifier is announced by Daly, Merritt & Sullivan, Inc., Falls Church, Va. This unit, designated Desomatic DOR-800, is available for industrial use in storage and packaging rooms with or without additional refrigeration for after cooling.

The machine has a dry air volume of 1500 cfm and has a rated capacity of 500 lb of water removed per 24 hours at air conditions of 70 deg. dry bulb and 35% relative humidity.

More information? Circle Item 13 on postcard, page 137

Aluminum Heat Exchanger Tubes

Welded aluminum heat exchanger tubes are being produced and marketed by Aluminum Company of America, Pittsburgh, Pa. The tubes are made by longitudinally butt welding Alclad 3S-H12 aluminum alloy sheet, rather than drawing seamless aluminum tubes. The same process may be used in making tubes for applications other than heat exchangers.



In the two standard sizes now available, 1-inch outside diameter with .049-inch and .065-inch wall thicknesses, welded aluminum heat exchanger tubes are said to cost 20% less than seamless aluminum tubes and substantially less per foot than tubes of other commonly used metals. Shortly, Alcoa expects to be producing ¾-inch welded tubes also.

In addition to being lower in cost than tubes made from other metals, the welded heat exchanger tubes have the protective Alclad coating on both the inside and outside surfaces rather than on the inside only as in seamless aluminum tubes.

The photo shows an oil-to-oil heat exchanger bundle made with 3S-H14 aluminum alloy tubes.

Catalog AD-186 is available.

More information? Circle Item 14 on postcard, page 137

Pipe Fitting Insulation

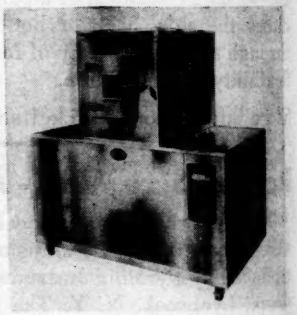
National distribution of a new pre-formed pipe fitting insulation, made by Birma Products Corp., will be by Sall Mountain Company, Hamilton, Ohio. This new product is a natural adjunct to the Sal-Mo line of pipe coverings.

The new product, which has been trade named Nicolet pre-formed fitting insulation, is constructed principally of glass fibers, is preformed to fit all tees, ells and 45° fittings, and is said to insure uniform high efficiency in pipe fitting insulation.

More information? Circle Item 15 on postcard, page 137

Testing Chamber

A test chamber, Model A-4½-100FHH, for production line and experimental testing is introduced by Webber Appliance Co., Inc., Indianapolis, Ind. Combining high temperature, low temperature and humidity, this unit has a temperature range from 250 to −100 deg.



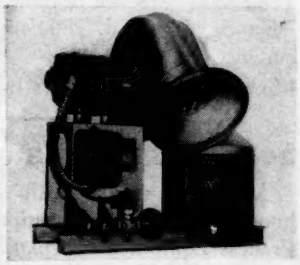
Accelerated pull-down is one of the features offered in this unit which can be cycled from ambient temperature to −100 deg in forty-five minutes and can be cycled from −100 deg to 200 deg in thirty minutes. Both high and low temperatures are governed by a temperature controller with a scale range from −200 to 400 deg with a three degree control point differential, one and one-half degrees plus and minus.

Humidity is regulated by a wet and dry bulb controller which provides 95% relative humidity at temperatures between 75 and 95 deg. Vacuum equipment can be added to simulate high altitude conditions. The test chamber is 4½ cubic feet, 20 inches high, 20 inches wide and 20 inches deep. It is provided with a multi-paned port for observation and the interior is equipped with a moisture proof light for illumination.

More information? Circle Item 16 on postcard, page 137

Blower Type Gas Heaters

A new line of Homogenator blower-type gas heaters is introduced by Kilbury Mfg. Co., Lawndale, Calif. The units have been redesigned inside and out for improved combustion efficiency, greater safety, and more streamlined appearance. There is a basic model for suspended use, and console models for floor and suspended use, in 50,000 Btu per hour capacities.



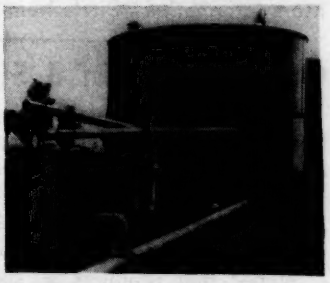
The heaters are approved by AGA as unvented circulators. High combustion efficiency is obtained by burning gas with induced air draft and a secondary cone over the burner for stabilizing the gas flame. Safety is provided in automatic controls that include 100% pilot shut-off valve, limit control to shut off gas in case of stalled motor or defective solenoid, and remote-type wall thermostat to eliminate overheating and vitiation of room air.

Units may be used with natural, mixed and manufactured gas, butane, propane, and LP-gas air. Natural gas and LP-gas air mixture of proper input rating and pressure can be used on the same burner without changing orifice or pilot; this is important to large industrial plants subject to gas shutoffs whenever winter shortages of gas develop.

More information? Circle Item 17 on postcard, page 137

Plastic Pipe Features Versatility

A new glass fiber-reinforced thermosetting plastic pipe for pressure transmission uses, designed to overcome many of the present limitations of plastic pipe, has been placed on the market by Reflin Co., Gardena, Calif. This pipe is said to have the following advantages: allowable pressures are high, resistance to heat and impact loads are great, physical properties at extreme temperatures are improved, friction is low, and the pipe is available in large sizes.



The new pipe is available in standard sizes of 4, 6, 8 and 10 inch O.D., in 20 foot lengths. Working pressure of the pipe is 200 psi and burst pressure is 1000 psi.

The material is resistant to most salts, acids, hydrocarbons and other corrosive elements commonly found in pipeline applications, the pipe withstanding aging or weathering in above or below ground conditions, and the pipe is unaffected by electrolytic corrosion, a major problem facing pipe users. The wide operating temperature range of the material, from minus 90 deg to 230 deg allows use at temperatures not possible with presently-used plastic pipe materials. In addition, the smooth wall surfaces discourage mineral and biological deposits.

Using standard fittings and simple tools the pipe, with completely leakproof joints, can be laid by two men under average conditions. Connections are made by sleeve-type couplers, Resin-Wrap joints, quick couplers, and other methods readily handled in the field. The pipe is adaptable to all standard auxiliary equipment including valves, pumps, and tanks.

More information? Circle Item 18 on postcard, page 137

Roof Ventilator in 3 Types

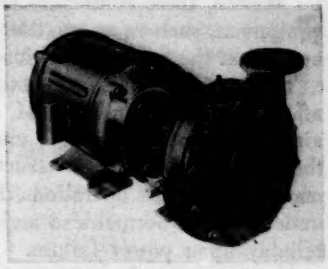
A completely die-fabricated roof ventilator has been placed on the market by Clay Equipment Corp., Cedar Falls, Iowa. It is available as a revolving head unit, revolving head with fan or as a stationary type ventilator. All types include base.

All ventilators are made of 26 gage galvanized steel and are finished with satin aluminum finish.

More information? Circle Item 19 on postcard, page 137

Leakproof Pump Seal

Development of a leak-proof mechanical seal for use in centrifugal pumps is announced by Bell & Gossett Co., Morton Grove, Ill. The new seal, known as the Remite floating seat, eliminates the leakage which sometimes occurs when conventional packing glands are used.

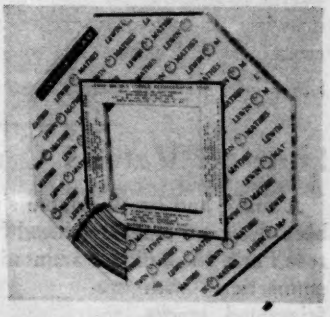


The seal, which is made of a composition of materials, is almost as hard as a diamond, and is both wear-proof and corrosion-resistant during its lifetime. No attention is required to maintain the seal as it is self lubricating.

More information? Circle Item 20 on postcard, page 137

Refrigeration Tube Carton

An octagonal carton with a square cut-out in the center, making it easy to pick up and carry, has been adopted by Lewin-Mathes Co., St. Louis, Mo., for packing refrigeration tube. The carton gives greater protection to the tube, is easy to handle and easy to stock and identify. It is similar to the Handi-grip carton which the company adopted for its copper water tube two years ago.

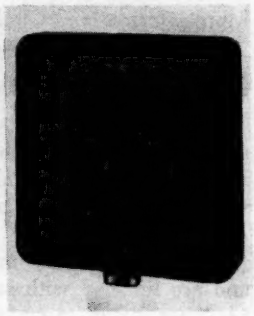


The carton is so constructed as to prevent distortion of the tube by means of eight-point contact instead of four-point contact. The tube is cushioned in every direction and held firmly to prevent its shifting in the carton. It is particularly well suited for distributor storage since it can be laid flat, stacked in horizontal racks or suspended on wall hooks.

More information? Circle Item 21 on postcard, page 137

Automatic Throwover Panel

An automatic throwover panel, a control device that transfers electric circuits to an emergency power source when the normal source fails, is announced by General Electric Co., Control Dept., Schenectady, N. Y.



For use in hospitals, restaurants, theaters, factories, and all places of public assembly, the new panel automatically transfers emergency lighting circuits, signal or communication systems, exit markers, regulating and metering equipment, or fire protection apparatus, to a standby power source when the regular supply is interrupted.

The panel consists of mechanically interlocked normal-source and emergency-source contactors, and a pilot contactor. Besides transferring circuits from a failed normal source to an emergency source and back again upon resumption of regular service, these contactors also control standby power equipment, such as an auxiliary generator, turning it on and off at the appropriate times.

The panel features a contactor whose air gap is not affected by the condition of the striking surface. The air gap is a permanent and unchangeable part built into the stationary magnetic structure and no matter how many or how few operations the throwover control may undergo, both normal-lead and pilot contactors drop out reliably upon power failure.

More information? Circle Item 22 on postcard, page 137

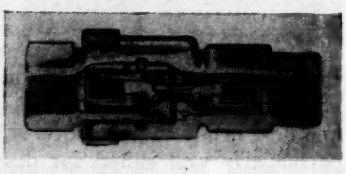
Slide Rule Has No Moving Parts

A combination slide rule and scale with no moving parts, the Space-Scale, is announced by New-Era Products, New York, N. Y. The device measures areas from scale drawings at a glance. Made of 5 x 5 inch transparent, laminated vinylite, it operates by placing over a drawing of space to be measured and reading figure on curve. Adaptable for use on any fractional inch scale drawing, it measures circles and cylinders as well as rectangles and cubes. The scale sells for $1.50.

More information? Circle Item 23 on postcard, page 137

Shut-off Valved Coupler

A make and break double shut-off valved coupler has been designed and introduced by Henry Valve Co., Melrose Park, Ill. Built for ammonia or Freon refrigerants in connection with refrigerated trucks, the coupler also has wide industrial applications wherever pneumatic or hydraulic lines are involved.

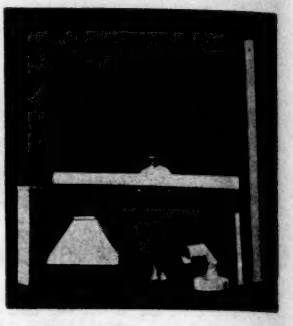


As the two halves of the unit are coupled together, the two piston valves open by moving away from their respective seats. A soft molded insert, mechanically held in place, forms the seat in each half of the coupler. True alignment of pistons is insured by long guides. Pistons can be readily replaced after long service, if necessary, by unscrewing seat bushings. An *O* ring in the socket half provides positive seal while coupling is connected. Proctector caps are provided for covering coupler halves when disconnected. The couplers are available in ½ inch connections.

More information? Circle Item 24 on postcard, page 137

Solid Plastic Fume Ducts, Hoods

A line of solid plastic corrosion-proof fume ducts, hoods and accessory equipment, is announced by Heil Process Equipment Corp., Cleveland, Ohio. General construction is offered in polyester glass combinations as well as rigivin, rigid vinyl type, and rigidene, polyethylene type.



Rigidon, the glass reinforced polyester resin combination, possesses the strength of light metals and is lighter in weight. Good acid resistance outside as well as inside reduces maintenance cost and the possibility of mechanical damage. This plastic material will withstand operating temperatures in excess of 200 deg and is easy to install because of its light weight construction and simple method of field joints.

Units are standardized in both round and rectangular duct sections and hood designs and manufactured in accordance with the latest recommendations for ventilating open process tanks by the American Standards Association.

More information? Circle Item 25 on postcard, page 137

Gas Burners in 8 Sizes

New Power-Flame series gas burners, made by Siemon Mfg. Co., Kansas City, Mo. are now available in eight models, in sizes ranging from 85,000 to 3,000,000 Btu per hour input. A tube within a tube principle is employed that produces a soft, yet extremely active flame with high radiant qualities.

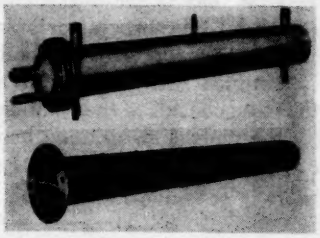
A new method of flame retention is said to eliminate the possibility of pulsation. One of the major safety features of the larger capacity units is a device that permits both pre-purge and post-purge periods to clear the heating plant of fuel both at time burner starts and at close of operation.

All controls are burner mounted and factory wired to facilitate installation in all types of heating plants.

More information? Circle Item 26 on postcard, page 137

Refrigerant Evaporators

The line of CWF shell and tube liquid coolers and direct expansion evaporators, for use in refrigeration and air conditioning systems, has been introduced by Taco Heaters, Inc., Providence, R. I. The evaporator is constructed according to ASME specifications, tested at 300 psi, and certified for 150 psi working pressure.



Refrigerant velocity is controlled to provide minimum pressure drop with efficient transfer and without oil logging. The liquid Freon is moved forward and is continually agitated to prevent flooding in the bottom or becoming oil saturated. The refrigerant is confined to the removable copper tube bundle.

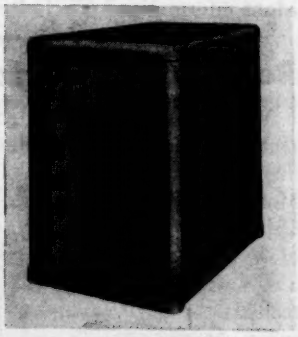
The baffles are electro tin plated with the spacing designed to provide proper velocity with minimum pressure drop through the shell. The baffles are furnished in accordance with the water quantities specified. Rolled steel heads are furnished with multi-pass circuits to permit the proper flow of the refrigerant and oil through the tube bundles.

The evaporator is available in shell diameters of 8 to 20 in two-inch increments and tube bundle lengths of 5 to 13 feet in one-foot increments.

More information? Circle Item 27 on postcard, page 137

Cast Iron Gas Fired Boilers

A new series of cast iron, gas-fired boilers has been developed by Norge Heat Div., Borg-Warner Corp., Kalamazoo, Mich. The three new series GB2, GB2.5 and GB4, cover a wide range of sizes from 62,000 to 2,380,000 Btu input per hour.



The smaller series GB2 boilers are available for hot water heating and the GB2.5 and GB4 series can be used with any steam, hot water or vapor system. The GB2 series, in four popular sizes, are shipped assembled from the factory with the controls, housing and burners all in place ready for connecting to gas and water lines.

These boilers are equipped with controls that are fully automatic and centrally grouped to facilitate easy inspection. Controls are available to meet local utility requirements. The cast iron fins on both sides of sections offer maximum heating surface to upward flow of hot gases. They stagger the hot combustion gases and impart a scrubbing action to the gases forcing them in close contact with every square inch of heating surface.

The boilers are approved by AGA for use with natural, mixed, manufactured, LP and LP-air gases.

More information? Circle Item 28 on postcard, page 137

Tube Radiator Has Bonded Fins

A fin-tube radiator whose extruded collared fins are bonded to a seamless steel pipe so as to become an integral part of it is a new development by Lee Vine Fin-Tube Radiator Co., Inc., New Haven, Conn.

The fin-tube radiator is available in stock lengths of 6, 8, 10 and 12 feet, and is also supplied in 6-inch increments from 2 to 12 feet. Each end of the pipe extends 2½ inches, and both ends are threaded or chamfered.

The radiator is designed for easy installation and to provide low-cost heating and maintenance in industrial and public buildings, institutions, offices, garages, hot houses, drying rooms, and for baseboard radiation in homes. Its design combines effectiveness with neat, modern appearance.

The company also manufactures expanded metal grille covers in lengths of 2 to 8 feet in 6-inch increments.

More information? Circle Item 29 on postcard, page 137

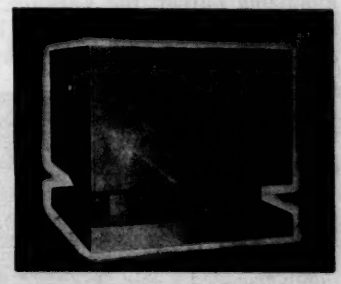
Radiant Heating Manifolds

A line of ceiling radiant heat flow and return manifolds is available from Copper Boiler & Heater Works, Manitowoc, Wis. Heaters are available in any length in sizes ½, 2, 2½, 3 and 4 inch sizes and with any number of spuds. A ¼ inch threaded vent is included.

More information? Circle Item 30 on postcard, page 137

Simplicity Features Ventilator

An automatic fan-powered roof ventilator of simple construction, the Airjet, has been designed by Hartzell Propeller Fan Co., of Piqua, Ohio. It is especially effective in clearing fumes and heat from above furnaces, foundry pouring floors, vats and other industrial equipment.



In outward appearance, the ventilator is a box, built of galvanized copper-bearing steel. All complicated and costly mechanisms of earlier designs have been eliminated. There are no counterweights or other obstructions to hinder the free flow of air.

Two hinged aluminum panels which are actually louvers form a weather-tight peak roof. They open automatically when the fan is started, close when it stops. When they are open, the air-stream prevents the entry of rain or snow. A standard propeller fan provides the air-movement.

More information? Circle Item 31 on postcard, page 137

Fuel Oil Check Valve

The Hold-Tite check valve for fuel oil piping is available from Hold-Tite Valve Mfg. Co., New York, N. Y. It is a combination of check, anti-hum and anti-siphon valve which holds the vacuum and keeps oil in the line.

The valve has a replaceable ball seat which can be replaced without removing the valve from the line. Valve operates in any position, is less than 2 inches long, and is machined from solid brass bar.

The valve is made in three sizes, ¼, ⅜ and ½ inches, the smaller sizes selling for $1.35 and the largest for $1.50.

More information? Circle Item 32 on postcard, page 137

Felt Tape Has Permanent Bond

Pressure-sensitive felt tape with adhesive on one side is now available from Spring Packing Corp., Chicago, Ill. As it comes from the roll, the tape adheres under light finger-pressure to all surfaces, including metal, glass, wood, ceramics. For permanent bond, the adhesive is moistened with a liquid reactivating agent. The tape seals against dust, air, fumes, moisture; damps vibration; impedes electrolysis; resists flame, oil, fungus, mildew. It can be cut into shapes and gaskets.

It is claimed that the felt tape can not be permanently compressed, even under both heat and pressure; that it will not deteriorate, and always stays soft and pliable. It is made in impregnated-felt and unimpregnated types. Further facts are given in Bulletin 501.

More information? Circle Item 33 on postcard, page 137

New Burner for Packaged Boiler

Equipping of its line of packaged boilers with an air-atomizing burner, the Voriflow, is announced by Orr & Sembower, Inc., Reading, Pa. The new burner eliminates carbonizing and choking, providing consistently clean combustion. It operates at high efficiency while operating over the range of 30% to 100% of maximum load.

This new burner is not affected by viscosity changes in fuel, so that there is complete atomization of even the heavier fuels which ordinarily cause choking at the burner and refractory throat. Further, it can be throttled down to low firing rates, without using large quantities of excess air.

The air-atomizing burner is said to be mechanically simplified. The body is beryllium copper, the air tubes are brass, and the core and cap are stainless steel. The body holds the cap over multiple slots in the core forming converging flow paths for the atomizing air. As shown in the illustration, the oil flows through the central tube and through the individual perforations into the air stream. The atomizing air from the annular space remaining within the outer tube is introduced into the combustion chamber across the oil streams through the converging slots in the nozzle core. The dams near the end of the oil tube prevent dripping after shut down.

Only about 1% of the total fuel load combustion air is admitted with the oil for atomization which permits the close control of the combustion air. Heat is conducted by the body and air tube back to the plenum where it can be dissipated quickly at low temperature.

More information? Circle Item 34 on postcard, page 137

Wrought Copper Solder Fittings

Wrought copper solder-joint fittings designed especially for refrigeration and air conditioning service and which will hold air, water or gas are available from Chase Brass & Copper Co., Waterbury 20, Conn.

Advantages of wrought copper solder-joint fittings include ease of installation in tight places, expansion and contraction at the same rate as copper tube, and smooth inside walls that offer minimum resistance to refrigerant flow.

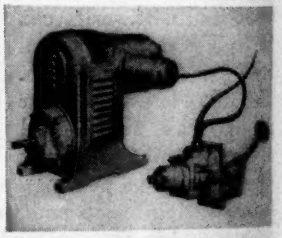
In tests, the fittings soldered to ½ inch copper water tube have withstood tensile pulls of 3800 pounds and internal hydrostatic pressure in excess of 5000 pounds per square inch.

Available wrought solder-joint fittings include sizes ranging from ¼ inch to 4 inches nominal size.

More information? Circle Item 35 on postcard, page 137

Remote Control for Motor Speed

Variations in speed of U. S. Varidrive motors by pneumatic remote control are now possible through a development of U. S. Electrical Motors Inc., Los Angeles, Calif. This control consists of a positioning unit, an air operated plunger attached to the Varidrive speed changing device, and an air valve which remotely controls the positioning unit. Four types of valves are available depending upon the method desired to operate the mechanism—pedal, lever, cam or wheel. The positioning units are designed to operate with an air pressure of either 60 or 100 psi.

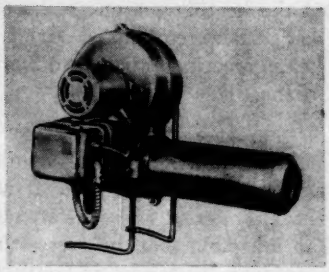


Through the use of check valves and control station selectors in the system, the speed of the unit can be changed from any number of control stations. Conversely, any number of varidrives may be controlled by one station providing they are to operate at the same speeds.

More information? Circle Item 36 on postcard, page 137

Power Gas Burner is Added

The Syncro-Flame power gas burner, designed to fit in vestibules of most gas and oil burning furnaces, and which is entirely independent of chimney draft, is introduced by Synchronous Flame, Inc., Chicago, Ill.



A swirling, forced mixing of air and gas results in rapid combustion with a short flame contained within the combustion chamber. The burner rapidly attains incandescence and transfers radiant heat to the heating surface of the appliance. Multiple air posts assure proper adjustment, mixing of air and fuel and good flame retention to nozzle.

A mercury switch, actuated by fan air pressure, assures sufficient air for combustion before the main gas valve can open. The pilot is ignited electrically by push button control; both pilot and main valve have an automatic safety shut-off in case of flame failure. Design of the shutter prevents complete air shut-off. A quick action solenoid controls on and off operation.

The burner is in 3 models ranging from 75,000 to 500,000 Btu per hour and available with either leg or flange mounting. The housing is heavy cast aluminum with a steel draft tube. The fan is accessible for cleaning and the inner assembly removes as a complete unit for servicing and cleaning. The motor is air cooled. The new burner will burn natural, manufactured or LP gases.

More information? Circle Item 37 on postcard, page 137

Water Conditioner in Capsule

A new boiler water cleaner and conditioner which is said to prevent priming, foaming, pitting, scale and corrosion in residential and small boilers, is announced by Dominion Products Co., New York, N. Y. The product, called Handy-Kaps, is a concentrated capsule, the contents of which are equal in effectiveness to a pound of powder or a quart of liquid. The capsules are said to assure accurate dosages with no pre-mixing. The service man can apply the material by simply dropping a capsule through the boiler's safety valve opening. The condition is a colloid which coats microscopic water impurities with a gel. This physical action, it is stated, eliminates the need for water analysis because it works in any water. Because of its handy concentrated form, a service man can carry a full days supply without concerning himself about the problems of space, weight and messy handling. The capsule permits greater heat transfer by increasing boiler efficiency and reduces boiler shut-downs and unnecessary service call-backs because the condition balances boiler water in the heating system and automatically protects, preserves and prolongs the life of the boiler metal by preventing and removing corrosion, grease, oil, mud, silt, scale, gases and silica.

Sid Harvey, Inc., Valley Stream, N. Y., has been appointed distributor of the product.

More information? Circle Item 38 on postcard, page 137

Portable Temperature Controller

Announcement of a portable precision temperature controller is made by Taco West Corp., Chicago, Ill. This new portable Gardsman instrument is intended for laboratory technicians, research and testing companies and firms which require intermittent use of control instruments at different locations thoughout the plant.

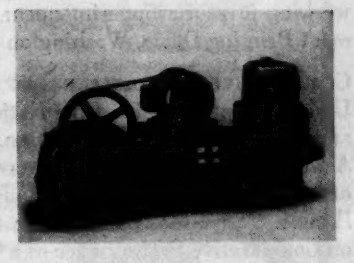
Precision control is accomplished by plugging the instrument into a wall outlet and plugging the unit to be controlled into the instrument. Then, by inserting the instrument thermocouple into an oven, bath, or thermocouple well, the true temperature will be indicated by the upper pointer and may be controlled at any desired point by setting the lower pointer to the correct scale position by means of the external setting knob. Two power outlets provide versatility by enabling it to control not only temperature but other factors, blowers, fans, agitators as well. Thermocouple break protection is provided at no extra cost, protecting the thermal system from overheating if a thermocouple should burn out.

The controller is available in three different models. The Model JE is the on-off type controller; the Model JEP incorporates the same proportioning type control as in the company's standard proportioning controller; and the Model JEL is a combination instrument serving either as a high limit controller or an on-off controller.

More information? Circle Item 39 on postcard, page 137

Heavy Duty H. P. Pumps

A line of heavy duty high pressure shallow well reciprocating type pumps is introduced by Lancaster Pump and Mfg. Co., Inc., Lancaster, Pa. Capacities range from 265 to 2700 gallons per hour. Called Lancaster Giants, these pumps are slow speed, double-acting and self-lubricating. They are powered by either electric motors or gasoline engines. The smaller models have herring bone gears while the large units have helical precision cut gears. They are designed for industrial water supply or heavy duty applications for boiler feed and condensation return and are available with a great variety of plungers and valves to suit individual requirements, liquids, etc.



More information? Circle Item 40 on postcard, page 137

Abstracts AND Reviews

Publications abstracted in this department should be ordered direct from publisher.

PHYSICAL-CHEMICAL PROPERTIES OF METHANE-NITROGEN MIXTURES—Reliable, adequate data on the methane-nitrogen system, necessary for engineering design of nitrogen removal equipment is presented in Institute of Gas Technology Research Bulletin No. 17. The studies reported were initiated in 1947 under the Institute's basic research program and since 1950 have been sponsored by the Technical and Research Committee, Natural Gas Department of the American Gas Association. The rapid rate at which natural gas reserves are being used forecasts the need for using supplies of increasingly higher nitrogen content. Of added interest is the storage of natural gas as liquid which requires the separation of nitrogen in the liquefaction process. Illinois Institute of Technology, Technology Center, Chicago 16, Ill. Price, $3.50.

LABORATORY DESIGN FOR HANDLING RADIOACTIVE MATERIALS—Sponsored by The American Institute of Architects and the Atomic Energy Commission, the Building Research Advisory Board conducted a meeting to cover Laboratory Design for Handling Radioactive Materials. The various talks presented at this conference together with the discussions that followed are contained in B.R.A.B. Conference Report No. 3. This report of 140 pages, covers the air supply and exhaust in laboratories handling radioactive materials, disposal of radioactive wastes, and other topics bearing on this subject. The Building Research Advisory Board, 2101 Constitution Avenue, Washington, D. C. Price, $4.50.

PACKAGING OF FITTINGS—Simplified Practice Recommendation R248-52 of the Office of Industry and Commerce, U. S. Department of Commerce covers Packing of Standard Malleable Iron Screwed Pipe Fittings, Black or Galvanized (for pipe sizes 2 inches and under). At the request of the American Gas Association, and with the cooperation of manufacturers, a simplified schedule of standard packaging has been established for fittings having a 150 lb. steam working pressure. Superintendent of Documents, Government Printing Office, Washington 25 D. C. Price, 5 cents.

COMPARATIVE PERFORMANCES OF WARM AIR SYSTEMS—Under the sponsorship of the National Warm Air Heating and Air Conditioning Association, and the American Gas Association, comparative tests were conducted on two types of heating systems in a test house at the University of Illinois. Results are published in Bulletin Series No. 401 on Comparative Performance of a Warm Air Ceiling Panel System and a Convection System. The convection system was a conventional forced warm air heating system which included an extended plenum trunk duct and high sidewall registers. The results obtained were compared with a warm air ceiling panel system in which no heated air was introduced into the rooms. The two systems were connected to the same furnace and were operated alternately throughout the heating season so that a wide range of weather conditions were obtained during the tests of both systems. The Engineering Experiment Station, University of Illinois, Urbana, Ill.

CLASSROOM NATURAL VENTILATION AND LIGHTING—A key factor in utilizing natural ventilation and lighting is the geometry of the classroom. It was found that in natural ventilation, greatest speeds are obtained with outlets larger than inlets but that the greatest volume of air flow is obtained when both inlet and outlet are maximum. Results of this study are presented in Research Report 36 on Geometry of Classrooms as Related to Natural Lighting and Natural Ventilation. Classrooms of various dimension arrangements were tested by researchers in an effort to determine what could be expected from nature. Texas Engineering Experiment Station, College Station, Tex.

APPARATUS FOR MEASURING GAS LAW DEVIATIONS—Bulletin No. 13 of the Institute of Gas Technology, covers Measurement of Gas Law Deviations with Bean and Burnett Apparatus. It presents a comparative study of this apparatus as to accuracy and reproducibility in determination of deviations from the ideal gas law, ease of operation in obtaining data and in calculation of the results. The bulletin describes the operation and calibration of new equipment, gives sample data and calculation sheets, and precautions to be observed in charging the equipment. Institute of Gas Technology, Illinois Institute of Technology, Technology Center, Chicago 16, Ill. Price, $2.

DESIGN STUDIES OF GAS DEEP FAT FRYERS—Research Bulletin No. 66 on Design Studies of Gas Deep Fat Fryers presents both practical and theoretical analysis of all factors affecting performance of such units. Fat deterioration studies aided the development of an improved fryer by showing that local kettle wall temperatures up to 650F were not necessarily detrimental to fat. Heat absorption studies of french fried potatoes yielded a method of calculating their heat requirements as roughly as 600 Btu per raw pound. American Gas Association, 420 Lexington Avenue, New York 17, N. Y. Price, $2.

I-B-R TESTING AND RATING CODE—The fifth edition of the I-B-R Testing and Rating Code for Low Pressure, Cast Iron Heating Boilers has just been made available. This code, originally approved in 1939 has been amended from time to time. The present edition contains two major changes (1) piping and pickup factors for automatically-fired hot water boilers with a gross output up to 1,254,000 Btu per hr have been reduced and (2) a new part 4 has been added covering Testing of Conversion Gas-fired Boilers. The code is divided into the following five parts: Rating of boilers; testing of hand-fired boilers; testing of oil-fired boilers; testing of conversion gas-fired boilers; procedure for obtaining I-B-R ratings. Included in this 92-page code is an appendix covering definitions of the terms used. The Institute of Boiler and Radiator Manufacturers, 60 East 42nd St., New York 17, N. Y. Price, $5.

Revere Copper Water Tube is made to order for remodeling. For you don't have to "tear down the house" to install it. When you use Revere Copper Water Tube it's a plumbing job for you and not a major alteration job. Often, it is possible to simply run it through the floors and partitions to the basement without even taking out the old piping, such as workman in picture is doing.

Why Revere Copper Water Tube is easier and faster for you to install is shown in panel at right. For these reasons Revere Copper Water Tube is more profitable for you to use. There are no worries about rusting and once installed you can forget it. Customers are satisfied and your reputation is protected.

Now with restrictions eased, and permissible quantities without allotments greatly increased, there isn't any reason why on your next job you can't take advantage of the many benefits of Revere Copper Water Tube for radiant panel heating, hot and cold water lines, underground service lines, oil burner service lines, and waste stack and vent lines. See the Revere Distributor nearest you today. And, if you have technical problems, he will put you in touch with Revere's Technical Advisory Service.

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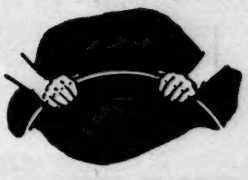


EASY TO BEND

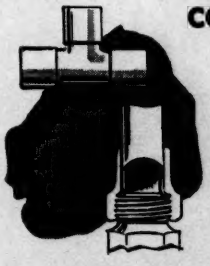
Saves Time

Revere Copper Water Tube is easy to bend. Soft temper can be bent by hand to meet installation conditions. Hard temper by hand bending tools.

HANDY LENGTHS

Save Fittings... Labor

Revere Copper Water Tube comes in straight lengths of 20' in hard and soft tempers. 60' coils of soft temper reduce the number of fittings needed.



SOLDER OR COMPRESSION FITTINGS

Need Less Work Room ... Save Metal

No worry about wrench room when you use Revere Copper Water Tube with solder fittings. Compression fittings can also be used. No threading is necessary with either type fitting. Wall thickness of tube used can thus be less than for threaded pipe.

NON-RUSTING

Rustable pipe eventually clogs as shown in drawing at top right. Non-rustable Revere Copper Water Tube suffers no loss of flow or pressure as shown at bottom right. No allowance in pipe size need be made for rust accumulation with Revere Copper Water Tube.

NEWS OF THE MONTH

SUB-ARCTIC TUNNEL

for a British Columbia sub-terranean power project offers special problems in piping and ventilation.

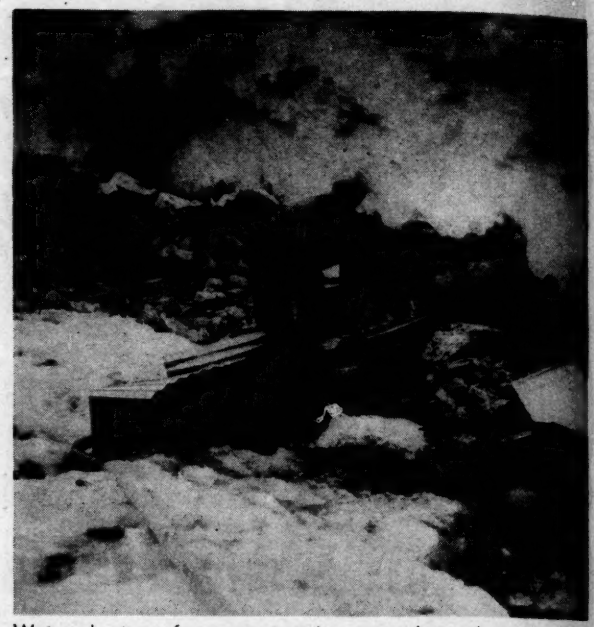
The vast underground workings connected with the Aluminum Company of Canada's immense hydroelectric power project, located in the wilderness 400 miles up the British Columbia coast from Vancouver, pose special problems in ventilating and piping.

In this wilderness area, the world's largest powerhouse is being built inside a mountain to protect it from rock slides, heavy snows, and the possibility of air attack.

• **AIR.**—Since the entire powerhouse, a cavern two blocks long and eight stories high, as well as the penstocks and a subway-size tunnel ten miles long carrying water from a chain of lakes back of the coastal mountains, must all be dug from solid rock far below the surface, ventilation is a prime problem. The men working at the headings of the tunnels must have a constant supply of fresh air, and providing this vital necessity is not easy at distances some two miles from the surface.

Crawler tractors such as the huge 180-horsepower International TD-24 and numerous diesel-powered haul units operate in the underground workings. Exhaust from these units must be cleared from the air rapidly to prevent contamination.

All supplies for the main tunnel being driven into the mountain from a half mile above valley floor camp reach the tunnel portal via this aerial railway. Here a big tractor has just been brought up as the nine-ton cable car begins its trip to valley floor. All tunnel equipment, including ventilation fans and pre-fabricated sections of vent pipe, were carried up on the aerial railway.



Water shortage for a construction camp located on top of a mile-high pass is solved by Russ Boyington with a trough and a fire hose. Boyington found where the water was melting off a 60-foot-deep snow bank and improvised his catchment apparatus on the spot. Camp is a hundred-man unit for which all supplies are flown up by helicopter. Men will live in aluminum-sided frame buildings during construction of mountain power line.

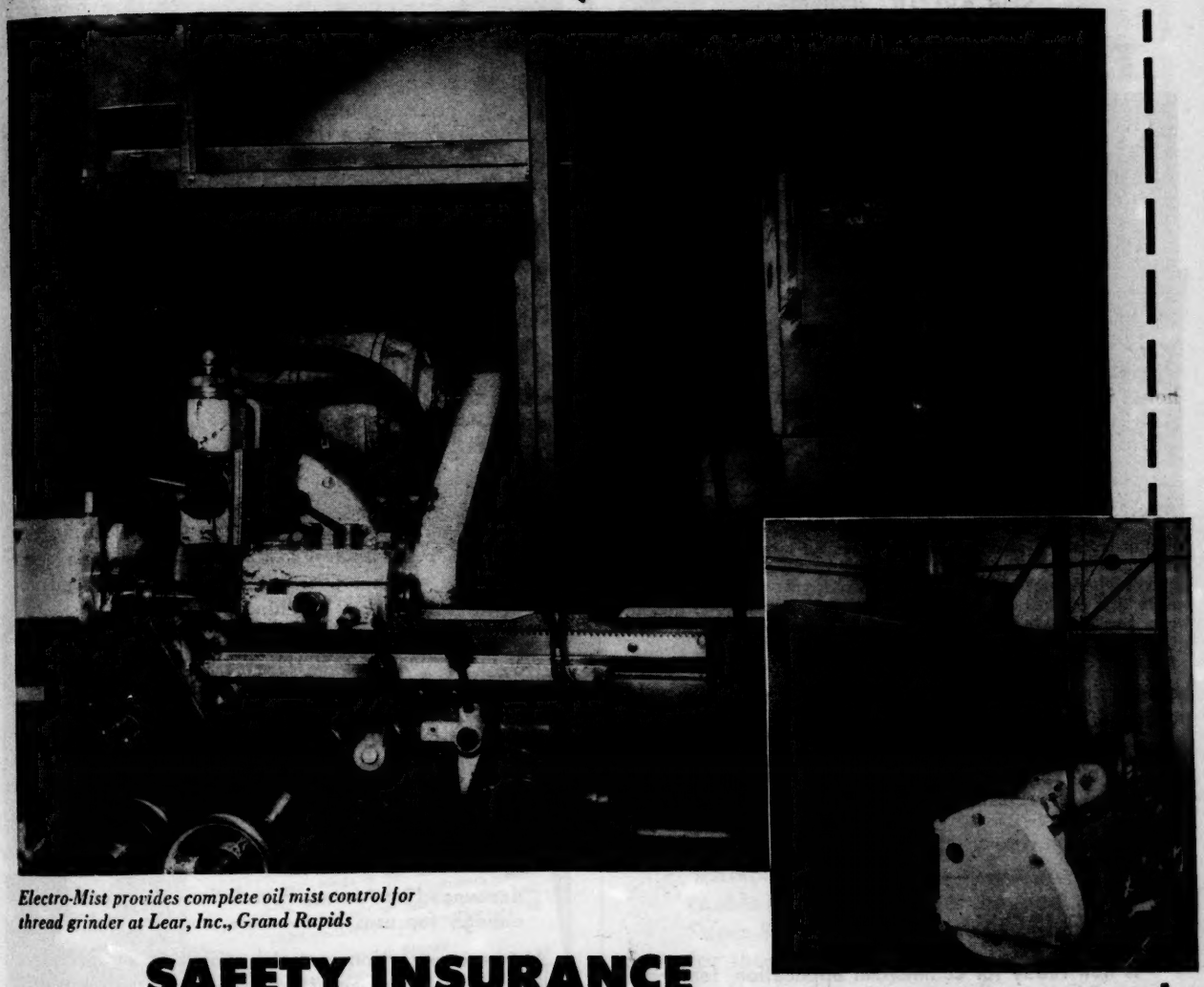
• **VENTING.**—All of the tunnels carry a 24-inch welded-steel ventilation pipe through which air is forced by electric-powered blower fans to within 200 feet of the actual heading where work is in progress.

To further lessen the degree of air contamination, the tractors which must work constantly underground have

(*Continued on page* 124)

Interior view of main tunnel shows extensive use of rigid and flexible pipe, hoses, and conduits of all types. Large, welded steel ventilation pipe is shown at upper right supported by a mobile frame. Thousands of feet of this pipe are fabricated in the construction camps and used in every one of the ten to fifteen tunnel headings being driven simultaneously.

today's best buy is better air!



Electro-Mist provides complete oil mist control for thread grinder at Lear, Inc., Grand Rapids

SAFETY INSURANCE
for high speed cutting and grinding!

Electro-Mist unit collector eliminates oil mist and smoke at the source.

The hazards created by coolants and the nuisance of oil mist and smoke from high speed grinding and cutting operations are completely controlled by AAF's Electro-Mist collector. A self-contained unit designed specifically for this purpose, the Electro-Mist exhausts material at the source by combining heavy duty industrial filters with electronic precipitation. Its unique design allows easy removal of collector plate assemblies, as well as access to all parts . . . without tools . . . thus reducing maintenance to a minimum.

The Electro-Mist also salvages as much as 2 to 5 gallons of coolant daily in its oil reservoir, which may be piped back into the machine or drained off, as desired. The above illustrations show how the plastic front of the hood may be raised for observation or adjustment, or when lowered, provides complete enclosure for the grinding or cutting operation.

If you are interested in safer, cleaner *high speed* grinding and cutting operations call your AAF representative today or write for complete details on Electro-Mist contained in AAF Engineering Bulletin No. 251.

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SUB-ARCTIC TUNNEL

(*Continued from page* 122)

Worker installing sewer and water lines for mountain construction camp checks pipe joints. Wooden frame will be closed with boards, filled with sawdust, and covered with tar paper to insulate line against early freezing weather. Large quantities of water are used at this camp by miners who, working in deep tunnels, take showers after every shift.

been equipped with a scrubber which removes a large portion of the carbon monoxide from the exhaust.

These facilities and precautions have provided a constant, ample supply of reasonably pure air for the men and machines performing heavy-duty tasks far from the surface.

DUCTILE IRON

is now ready for commercial application, featuring flexibility due to its fluidity and high strength.

Ductile iron, experimentally introduced by the International Nickel Co. in 1948, has reached the stage where it can be used in industrial applications. Foundries throughout the United States are licensed for production, and the industry has noted appropriations of several million dollars for this increased production.

It is a high carbon ferrous product containing graphite in the form of spheroids. Gray cast iron, because its graphite is in the form of flakes which form a multitude of notches and discontinuities in the metallic matrix, is a relatively weak and brittle material. The addition of a small amount of magnesium to the molten metal before pouring compacts the graphite into the form of spheroids and reduces the internal notching to a minimum. A cast iron is formed that can be bent, twisted, and deformed without fracture, and which is much stronger than gray iron.

• **SOLUTION.**—Ductile iron, because it can be produced in the cupola and because of its fluidity, has wide flexibility with respect to the size, intricacy, and number of castings that can be reproduced at any one time. Add to this its high mechanical properties, and a solution is found for castings that are too intricate to be cast in steel, and which have inadequate mechanical properties when cast in gray iron.

• **STRENGTH.**—An indication of its high strength can be seen in a comparison of its tensile strength with that of gray iron and cast steel. In the state as cast, ductile iron has a UTS more than double that of gray iron, running about 90,000 psi to 40,000 psi. In the annealed state the UTS comparison is as follows: Ductile iron, about 70,000 psi; gray iron, about 16,000 psi; cast steel (grade B), 68,000 psi.

Ductile iron can be readily arc welded following the techniques used in welding gray iron. A number of ductile iron parts are now welded to steel, highly alloyed materials, and to ductile iron itself, all in routine fashion. The tensile strength of the weld metal is about 60,000 psi and the amount of ductility will range up to 10% or even higher.

• **PROPERTIES.**—Besides its high tensile strength, ductile iron has shown other fine properties. It has high wear resistance, resistance to heat and oxidation at high temperature superior to that of gray iron, fatigue resistance comparable to ordinary grades of steel, good yield strength and shock resistance, ability to withstand impact loading, and easy machinability.

• **USES.**—These properties and combination of properties have made the material useful in pumps, valves, gears, centrifugal cast pipe, and many other applications which had been the special field of cast or forged steel and gray or malleable iron.

LIGHTWEIGHT AGGREGATE

announced by Armour Foundation is fluid and strong enough for uses in concrete, mortar, and plaster.

A new construction material consisting of tiny glass balloons, about the size of grains of sand, with potential applications in the building trades has been described by John Neff, ceramics expert at Armour Research Foundation of Illinois Institute of Technology. Trade-named Kanamite by Kanium Corporation, Chicago, which sponsored the development work, the material is a fine-grain lightweight aggregate made by blowing up individual grains of clay in a special furnace.

Concrete mixes using the new material in place of sand or other aggregates are very fluid, even though water content is low. This fluidity means that contractors can fill forms with concrete pumped through rubber hoses.

• **STRONG.**—The strength of the material has been demonstrated by making plaster specimens with it that show a compressive strength greater than that of specimens made with sand. The high strength of plaster made with the new aggregate will allow thinner coatings of plaster to be used on walls than are now possible. Being strong as well as light, the relatively thin layer of the plaster is able to support its own weight. Plaster board, too, can be made thinner and lighter while retaining adequate strength, according to Mr. Neff.

• **DESIGN.**—Individual particles of the new material are almost spherical. Their size varies with the raw material

(*Continued on page* 126)

Designed by *EXPERIENCE*... Proven by *SERVICE*

Fairbanks *Micro-Control* Valves

150 lb. Bronze Globe Type

Fairbanks MICRO-CONTROL Bronze Globe Valves give you Needle Valve control and the durability of stainless steel. Here are the outstanding features of these Fig. 0525 Valves:

***Stainless Steel Plug Disc and Seat**
Hardened to 500 Brinell, these parts resist corrosion, wire-drawing and abrasion due to solids in the fluid stream. The plug discs and seats are precision ground in *matched sets* to insure a perfect seal. These parts may be reground for long life.

***Two Piece Union Bonnet**
Permits ready access to valve disc and seat for regrinding or replacement without removing the valve from the line.

***Radial Seat**
The radial seat of the Union Bonnet is an EXCLUSIVE Fairbanks feature. It assures a tight body-bonnet joint and rigid alignment of all parts.

Fig. 0525 Bronze Globe Valve 150 lb. steam working pressure. Also available for 200 lb. and 300 lb. pressures.

Fairbanks 0525 Bronze Globe Valves are a dependable combination of precision working parts and solidly built body... designed especially for close regulation of flow.

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ALL SET FOR WINTER?

Check Your Unit Heater Steam Traps Now

Be prepared for winter. Equip every unit heater now with a Super-Silvertop Steam Trap. These traps quickly remove the cold, dead air from the core of unit heaters and permit them to fill up with hot, dry steam. By draining all water and condensate out of the coils, Super-Silvertops enable heaters to produce maximum heat. Super-Silvertops save enough fuel to pay for themselves by winter's end!

Super-Silvertops can be serviced without disturbing a single pipe fitting . . . and the patented guided bucket eliminates bucket damage common with other traps. The booklet "Solving Steam Trap Problems" contains complete data on selecting steam traps for unit heaters. Write for your copy today.

Use Straight-in-Line or as an Elbow

THE V. D. ANDERSON CO.

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Gentlemen: Please send without obligation "Solving Steam Trap Problems".

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In Canada: Bawden Industries, Ltd., Toronto

See our exhibit booths 83 and 84 at the 20th National Exposition of Power Mechanical Engineering.

LIGHTWEIGHT AGGREGATE

(*Continued from page* 124)

used and the method of processing. Sizes from .0116 inch to .0069 inch in diameter seem to be the most useful.

The material is made in mid-air in a special furnace. Ground and screened clay is fed into the top of a vertical furnace. The individual grains of the raw material melt in the approximately 2700F heat of a gas-air flame as they fall through it.

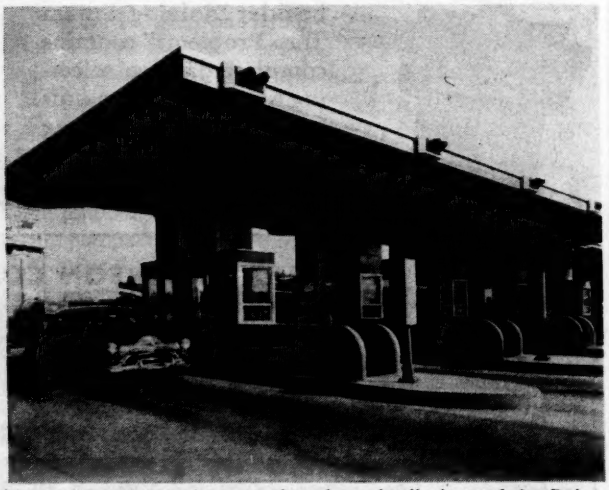
Gases given off by the tiny melted blobs at the correct instant inflate them into hollow spheres. The little glass balloons drop out of the flame and cool during the remainder of their fall. They are collected at the bottom of the tall furnace.

• **APPLICATIONS.**—The material has potential applications in addition to the concrete, mortar, and plaster mixes already mentioned. As an ingredient of baked clay products it could make possible lightweight refractories and high-temperature insulating materials. It has possibilities as a filler in plastics and road-building materials.

RADIANT HEATED BOOTHS

solve the dual problem of how to provide comfortable heating and eliminate fumes from toll plaza.

Probably the smallest buildings in existence with modern floor-type radiant heating are the 15 new pay booths on the recently enlarged toll plaza of the Delaware River Bridge, Camden, N. J. Each booth is heated by a unit of six embedded runs of wrought iron pipe. The heating systems, connected by a tunnel, use hot water circulated through the pipes from a steam converter located in the basement of the new administration building. A pressurized heated air system in the booths was incorporated for the fume problem.



New toll booths on the recently enlarged toll plaza of the Delaware River Bridge, Camden, N. J., are heated by a floor-type radiant heating system of embedded wrought iron pipe.

• **PROBLEMS.**—Experience in the bridge's former toll booths, heated by conventional radiators, indicated several factors which required special consideration in planning the new heating system.

Too much heat near the ceilings of the small booths, which measure 2¾ feet x 8 feet, had created a hot, stuffy atmosphere at head level, causing body discomfort and unpleasant working conditions. The combination of systems prevents this.

Cold air entering through frequently opened doors or windows gave attendants chilled arms and cold feet. The warm floors now provided assure wintertime working comfort.

Automobile exhaust fumes infiltrated the booths and hung in the air presenting an occupational health hazard for the attendants. These fumes are now removed.

• **CREDITS.**—Consulting Engineers in the renovation were Modjeski and Masters of Harrisburg, Pa. Harbeson, Hough, Livingston, and Larson of Philadelphia were the architects. Louis T. Klauder and Associates of Philadelphia provided the mechanical and electrical engineering. Daniel M. Kramer was the chief engineer for the Delaware Port Authority.

PROFESSIONAL ENGINEER DEFINED

by a Wage Stabilization Board interpretation of an amendment just made to Defense Production Act.

The Wage Stabilization Board has issued an interpretation defining the scope of the 1952 amendment to the Defense Production Act which exempts from stabilization controls the wages, salaries and other compensation paid to professional engineers employed in a professional capacity. The interpretation differentiates between professional engineers and its allied occupations and gives the special exceptions to the amendments.

• **INCLUDED.**—Persons who are professional engineers include:

(1) A person who, by reason of his special knowledge of the mathematical and physical sciences and the principles and methods of engineering analysis and design, acquired by professional education and practical experience is qualified to apply such special knowledge for the purpose of rendering professional services or accomplishing creative work, such as consultation, investigation, evaluation, planning, design, or supervision of construction for the purpose of assuring compliance with specifications and design in connection with structures, machines, processes, works or projects.

(2) A person who is qualified by reason of his professional education, if he holds a professional engineering degree from a college, university or institute of technology, authorized under the laws of the jurisdiction in which it is located to grant academic degrees in professional engineering.

(3) A person licensed or registered to practice as a professional engineer in any State, Territory, or possession of the United States or in the District of Columbia.

(*Continued on page* 128)

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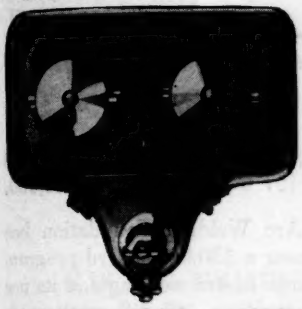
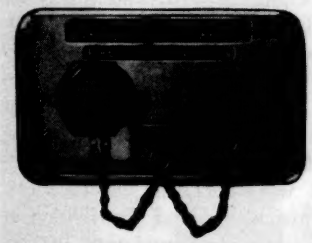
ALLENCO

Leader in INDUSTRIAL Fire-Protection Equipment

CONCEALED or FLUSH type SIAMESE



This Siamese minimizes projections from face of building. Body, with two independent self-closing clapper valves, can be inside or even built into wall. Extra heavy bronze, lasts for life of building. Siamese (inlet for F. D.) or wall hydrant (outlet for F. D.), with or without sill cock, full range of sizes. Complete line of standpipe equipment.



Whatever your wants in interior fire-protection equipment, you'll find ALLENCO provides the most *reliable* and *economical* product. See Sweet's Architectural Catalog File.

A. I. A. 29e2

ARCHITECT'S DATA BOOK— Allen on Interior Fire-Protection—packed with concise and complete specifications and practical working data to make your work easier. Available without cost to architects and engineers. Write for your copy or for a call by our Consulting Service . . . now.

Established 1887

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It's VILTER Again

in the new MILWAUKEE HOSPITAL addition

Long famed as one of Milwaukee's foremost private hospitals, Milwaukee Hospital recently completed a new wing that considerably broadens its program of hospital care for the people of the community. As it does in all modern hospitals, air conditioning played an important part in the expansion of Milwaukee Hospital.

Installed in the new wing, and supplementing other Vilter equipment, were two new Vilter 4-cylinder VMC Freon compressors, a shell and tube Freon condenser and receiver, and two Vilter air conditioning coils. The 40-ton Vilter compressors are provided with automatic capacity reduction to compensate for varying load conditions.

Hospitals know the importance of refrigeration and air conditioning that can be counted on—lives may depend on it. Industry as well must have cooling that is dependable day after day and year after year. Whether it is patient or product that needs care, Vilter refrigeration and air conditioning has a years-old record for staying on the job—and for doing it at consistently lower operating and maintenance costs. Vilter can save money dependably in *your* plant, too.

WRITE TODAY FOR BULLETINS 110, 120, AND 220

Vilter

Your nearby Vilter Distributor or Representative will be glad to show you how you can save money—now and for years to come—with Vilter Refrigeration.

REFRIGERATION and AIR CONDITIONING

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Ammonia and Freon Compressors • Pakicers • Evaporative and Shell Tube Condensers
Pipe Coils • Valves and Fittings • Air Conditioning

PROFESSIONAL ENGINEER DEFINED

(*Continued from page* 126)

• **EXCLUDED.**—Persons who are not professional engineers include:

(1) Persons engaged in carrying on routine mechanical activities, or persons employed as technicians or artisans (no matter how highly skilled), advisers on sales promotion, business methods and operations or in similar capacities. Consequently, persons whose occupations are designated as that of "engineer," such as stationary engineers, maintenance engineers, sales engineers or management or administrative engineers, are not professional engineers.

(2) Physicists, chemists, mathematicians, and other persons professionally employed in scientific fields, even though their scientific field or particular work activity may be related closely to professional engineering.

(3) Persons employed as engineering assistants, engineering aides, junior engineers or other engineering personnel who may work in more or less close association with professional engineers but who are not qualified to do the work of professional engineers.

• **EXCEPTIONS.**—The statutory exclusion from wage and salary stabilization extends to a professional engineer only if he is employed to perform engineering work of a professional character. A person, qualified as a professional engineer, may actually be employed in a position which does not involve the duties or responsibilities of a professional engineer. Such a person is not regarded as being employed in a professional capacity, even though he may be employed by a professional engineer or a firm of professional engineers.

For example, a qualified professional engineer may be employed in an executive rather than a professional capacity (such as vice-president in charge of sales of a firm of machinery distributors). Similarly, a professional engineer whose primary duty is that of an administrative employee (such as employment manager in charge of recruiting and placement of professional personnel) or that of an outside salesman (such as soliciting of contracts from governmental agencies for industrial concerns) is not employed in a professional capacity.

T. NAPIER ADLAM

dead after brief illness. Sarco executive was international authority on traps and radiant heating.

T. Napier Adlam, vice-president and general manager of Sarco Mfg. Co., Bethlehem, Pa., and technical director of Sarcotherm Controls, Inc., died October 22 after a brief illness.

Born in Monkton, Scotland, he attended Swindon Engineering College where he was a Whitworth scholar. He was working with A. H. Barker in England when Mr. Barker brought out the first patents on radiant heating. Later Mr. Adlam was recognized as an authority on radiant heating and was the author of a comprehensive series of articles on this subject which appeared in Heating and Ventilating in 1931, shortly after he arrived in this country. Another series on this subject was concluded in the September issue. In 1947 his book on Radiant Heating, now in the second edition, was published by The Industrial Press.

Mr. Adlam was equally well known for his knowledge of steam traps, on which he also wrote extensively. He was a member of the ASHVE, the Institution of Heating and Ventilating Engineers of England, the British Institution of Patentees, and a fellow of the Royal Society of Arts.

He is survived by his wife and daughter.

DESIGN AWARD PROGRAM

under the sponsorship of the Lincoln Arc Welding Foundation to offer 101 awards totalling $30,000.

The James F. Lincoln Arc Welding Foundation has announced that it will sponsor a $30,000 award program to stimulate scientific research in arc welding and its use in machine design and construction. 101 different awards will be presented by the program which ends July 27, 1953.

• **AWARDS.**—There are eighteen divisions, each for a different type of machinery, and each of which comprises a separate competition for a first, second, and third award of $500, $250, and $150, respectively. Papers will be chosen from those winning divisional awards to receive eight additional awards, ranging from $2,000 for first award to $700 for eighth award, and thirty-nine honorable mention awards of $100 each.

• **RULES.**—The award program will be open to all persons in the United States and its possessions who have actually been engaged in the design or manufacture of the machine or machine component described in the paper. For other information on eligibility, subject matter, time restrictions, patent restrictions, classifications, treatment of subject, requirements, and distribution of awards, the secretary of the Lincoln Foundation, PO Box 3035, Cleveland, Ohio, should be contacted.

DIRECT-FIRED HEATERS

are used to solve unusual engineering problems in designing a spacious warehouse in Ft. Wayne, Ind.

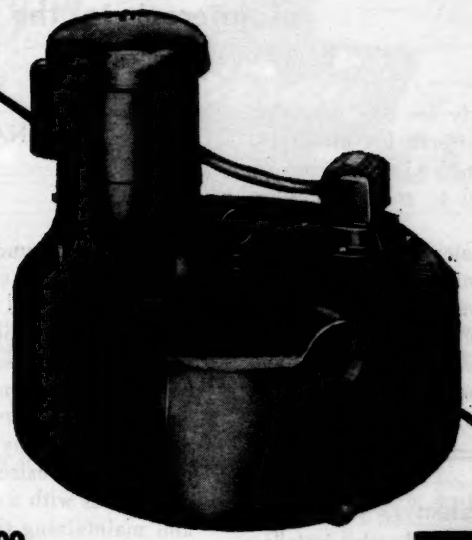
Heating a warehouse usually is difficult due to the problem of distributing heat effectively in large open areas equipped with bins and storage racks. Also, during the winter months, the frequent opening of large doors for trucks and railroad cars adds to the problem. Other factors to be considered include the amount of heat lost in the winter in a high-ceilinged building, and the amount of solar heat gained in the summer.

(*Continued on page* 142)

LOW PRESSURE SYSTEM

Condensate Pumps

weil Dependable PUMPS



weil TVC Pumps

Low Return Connection
Low Speed, Long Life
Cast Iron Receiver
Single or Duplex
Low Water Line
Capacities 500 to 10,000 Sq. Ft. E.D.R.

For Single Units
Dimensions: 10 gal. receiver
Diameter—21"
Height of return above floor—6⅞"

For Single or Duplex Units
Dimensions: 15 gal. receiver
Diameter—25½"
Height of return above floor—7 3/16"

ASK FOR BULLETIN TVC 300

Fig. TVC 126

Available from JOBBERS' STOCKS

weil PUMP CO.

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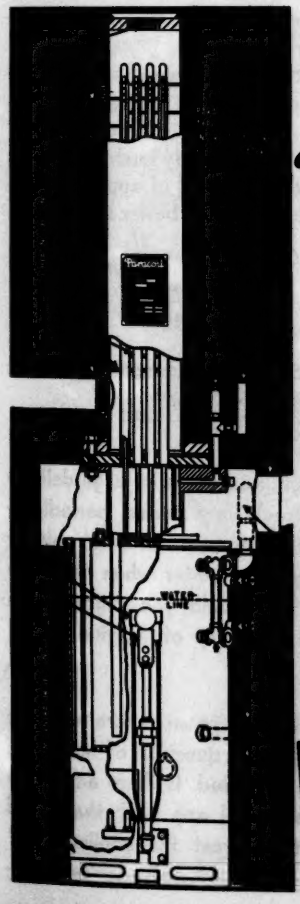

A GREAT NEW DEVELOPMENT IN OIL PREHEATER DESIGN

Paracoil Keeps Pace With The Rapidly Changing Needs Of The Oil Burner Industry

The TYPE "GF" INDIRECT GAS FIRED FUEL OIL HEATER

A RADICALLY NEW APPROACH TO THE PROBLEM OF ADEQUATE OIL PREHEATING UNDER ALL OPERATING CONDITIONS!

The Type "GF" Oil Heater is an integrated self-contained steam vapor generating exchanger using gas as its primary heat source.

However, the gas flame does not come in contact with the tubes containing the fuel oil. Instead, vapor from the lower steam generating section does the actual oil heating!

APPLICABLE TO ALL TYPES OF OIL FIRED APPARATUS!

As it is not dependent upon the unit it is servicing for the means of heating the oil, the Type "GF" Heater can be applied to any oil fired apparatus, be it a steam or hot water boiler, a process oven, a dryer or a kiln!

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- Supplementing inadequacies in present oil preheating systems.

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BULLETIN 60-L WRITE FOR YOUR COPY TODAY!

DAVIS ENGINEERING CORPORATION

What Would You Do?

Replies to engineering and operating problems of interest to the industrial plant engineer

Conducted by
NATHAN N. WOLPERT
Associate Editor

THIS is a department particularly for the industrial plant engineer. Here he can present his problems. Here he can benefit from the advice and experience of other engineers who may have had to solve a similar problem.

Please send your problems or whatever comments you may have regarding the questions announced for coming issues, to the Editor. Such letters are always welcome.

The current discussion is of general interest for it is concerned with the use of check valves and such valves are found in industrial plants, regardless of size.

This Month's Problem

I have just learned that a lift type check valve installation was connected backwards. There are no marks on the valve to show how to set it properly. Are there any guiding rules for the installation of check valves to insure good operation and maintenance?

Answers to This Month's Problem

Since check valves have no external moving parts which indicate direction of movement of the discs, it is relatively easy to install such valves backwards, if care is not used. This is particularly true of globe type lift checks which have symmetrical bodies with no visual indication of the position of the bridge wall or the disc.

The basic rule covering the installation of all check valves is that they must be applied so that the force of gravity tends to close the valve. The only exception to this rule is the case of the high pressure vertical type ball check valves which may be used in the horizontal position. While swing check valves can be used in horizontal lines and also for upward flow in any line inclined at any angle up to 90 deg from the horizontal, lift check valves of the globe type should only be used in horizontal lines although theoretically they could be used in lines inclined at angles up to 45 deg from the horizontal.

Lift check valves should always be applied to a pipe line in such a way that the movement of the discs is in a vertical plane. This is particularly true of lift check valves with metal discs, for here beveled seating surfaces are used which require that the discs be brought to the seats without canting or cocking if tight seating is expected.

The following service recommendations are suggested for lift check valves:

(1) All metal disc lift check valves of the globe, angle and vertical types are suitable for use on steam, air, gas and general vapor service providing that there are no severe pulsations in flow. Valves for air and gas should be specially ground and tested. All of these valves may be used on hot or cold liquid service, providing low resistance to flow is not a major objective.

(2) Composition disc lift check valves may be used on the same classes of service as metal disc valves and with the same limitations as far as pulsations are concerned. For low pressure air service, valves with soft discs are better than any metal disc valves and should be recommended. For extremely low air or vapor pressures, soft disc valves with a spring above the disc to aid in closing and maintaining tight seating surfaces should be recommended. Air service in general is hard on check valves and it is advisable, therefore, to use sturdy valves. On liquids which are hard to hold, composition disc valves with suitable discs will stay tight longer than metal disc valves.

(3) Ball type lift check valves are frequently used on service where gummy deposits are liable to form on guides and seats to such an extent that the ordinary type of valve might not operate properly.

(4) Cushioned type lift check valves should be used on steam, air, gas and all liquid service where severe pulsations in flow are present.

(5) Stop check valves are essentially cushioned check valves and have the same general field of application, although they are primarily designed for boiler lead service.

H. J. Martlett
Crane Co.

Chicago, Ill.

(*Continued on page* 132)

Problems for Coming Issues

December Issue

A small building separately houses eight large delivery trucks. Engines of these trucks are tuned periodically while the cars are still in the garage. An unsuitable air condition results, particularly in winter when the large doors are kept closed. What would you suggest as a suitable ventilating system to carry off engine fumes?

January Issue

In connection with a storage room where we keep material until shipped, there is a question of how often the cooling coils should be defrosted. Is there any visible indication or simple mathematical approach that would indicate when it is time to defrost the cooling coils?

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(*Continued from page* 130)

A lift check valve must be installed with the inlet below the disc, so that normal flow will lift the disc or open the valve and so that reverse flow will check or seat the disc, thus closing the valve and stopping the flow.

The pipe fitter, when installing the valve, can easily determine the inlet end of the valve by observation of the diaphragm through the pipe ends. Once the valve is installed, it is usually impossible, by visual inspection of the installation, to determine whether the valve is properly installed. If improper installation is suspected, it can be checked by removal of the cap. The open end observed through the cap end is the outlet of the valve.

Incidentally, for Lunkenheimer lift check valves, the name cast on the side of the valve body, reads in the direction of the flow.

Harry A. Burdorf
Vice President in Charge of Sales
The Lunkenheimer Co.

Cincinnati, Ohio

You have posed an interesting question and we think that its use in your "What Would You Do?" department has a lot of merit. Often we overlook the elementary simple problems such as how to install a check valve in our work on valving problems and it comes as somewhat of a shock for us to find that some confusion exists.

Generally speaking, all lift type check valves are marked to prevent them from being installed backwards. They have a directional arrow or the word "inlet" stamped on the hexagon end, or a line on the outside of the body to indicate the bridge wall position. Sometimes vertical check valves are not marked for direction of flow and here it is assumed that it is obvious that pressure must be under the disc to open. The position of the disc is clearly feasible in a vertical check valve. On any other lift check valve that is not marked, it is also assumed that the user will install the valve correctly with the pressure under the disc so that it will close against a back flow.

J. E. Bradbury
Manager, Alloy Sales Section
Crane Co.

Chicago, Ill.

The following data is from a booklet, "Instructions for the Installation and Maintenance of Valves," issued by Jenkins Bros., New York, N. Y.:

"Lift check valves are made in three patterns—horizontal, angle and vertical. The horizontal pattern must be installed horizontally and level so the internal parts rise and fall in a vertical plane. Flow should be beneath the seat for effective action and tight closure. The angle pattern must be installed with flow upward from beneath the seat. The vertical pattern is for use on vertical pipe lines only; it must have the flow upward from beneath the seat."

A valve company engineer reported, "It is quite possible to have this problem due to the fact that manufacturers do not have an arrow cast on the body of their valves or the inlet stamped so as to indicate the correct position to install a lift check valve. The reason manufacturers do not adopt this practice is largely due to manufacturer's facilities where they have multiple-plate patterns. Although our lift check valves are not so marked, we do not hesitate to stamp a valve for a customer, when requested."

Previous Problem

The following comments pertain to the problem discussed in the October issue regarding complaints of drafts by plant employees working close to large windows.

Without knowing any more about the plant, I would say that due to exhaust equipment throughout the entire plant, that the building is under a partial vacuum. Because of this there is an increase in the infiltration and this cold air passes over those people located close to the windows before being heated. If this is true, the only practical solution is to install air supply units capable of tempering sufficient outside air and supplying it to the building to balance that being exhausted. These units can be either made of coils and use steam for heating or, if there is not boiler capacity, can be direct-fired units.

The heating load on the boiler will not be increased if the infiltrated air is now heated before being exhausted. Figures show it is considerably cheaper to heat this air if it is brought directly to the tempering unit and then discharged in the proper location rather than allowing cold air to pass over workers before being heated.

In many cases, by carefully locating the air supply units to get the maximum travel between its point of entry and point of exhaust, many general ventilation systems can be eliminated or reduced. We have had cases where we have been able to reduce the exhaust requirements of a plant by as much as ⅓ by proper location of correct quantities of make-up air.

K. E. Robinson
Consulting Ventilation Supervisor,
Division of Industrial Health

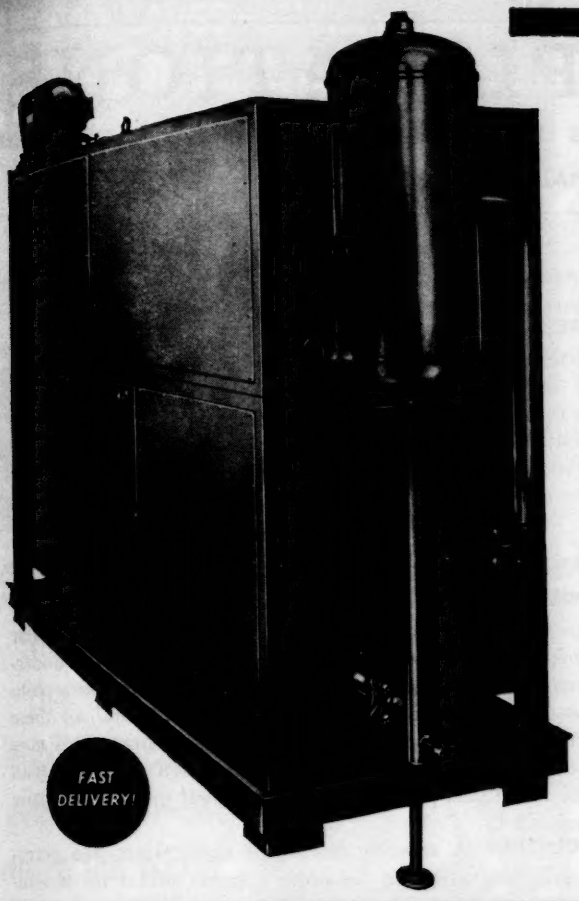
Lansing, Mich.

Jet Plane Cockpit is Air Conditioned

The U. S. Navy's newest fighter, the "Bat-wing" Douglas F4D, will be equipped with air cycle refrigeration units built by Hamilton Standard Division of United Aircraft Corporation. These units are required to cool the airplane's cockpit and electronics equipment compartment.

According to Erle Martin, general manager, each unit weighs 14.7 lb and is believed among the lightest ever developed to deliver 20 lb of air a minute. When in maximum operation it bleeds air at over 600F from the jet engine, passes it through a heat exchanger and a tiny turbine, and delivers it to its destination at 20F, all within a short time.

The air in the F4D's cockpit is changed 260 times an hour, and does a cooling job at a rate equal to that involved in the manufacturing of almost two tons of ice per day.



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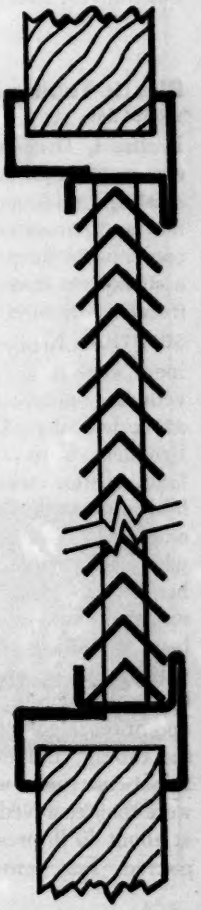

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PRODUCT APPLICATIONS

New, Unusual, or Ingenious Uses of Equipment and Materials

Conducted by WM. B. FOXHALL, Associate Editor

Steam Generator Rented for Emergency

PROBLEM: At the General Tire & Rubber Plant, Baytown, Texas, each of three boilers had to come off the line for repairs at the same time. Process steam to keep up production was to be cut off entirely.

SOLUTION: An arrangement was worked out whereby a Vapor-Clarkson steam generator was rented from Texsteam Corp. of Houston, Texas. The installation of emergency equipment was accomplished in two days. A concrete base was poured and the next day a complete steam generator was shipped on one truck, unloaded and installed and on the line in a few hours.

RESULTS: This gas fired steam generator is producing 22,000 lb of steam per hour at 165 psi 24 hours a day. No men were added to take care of the unit which is automatically controlled. General Tire plans to rent the machine for four months while their boilers are repared.

Plastic Tubing Used for Radiant Panel

PROBLEM: At the Pump, Pipe and Power Company of Portland, Oregon, plans for plant expansion included construction of new buildings as well as renovation of existing buildings. Radiant heating was selected for both new and converted buildings and it was the desire of the company to keep installation costs at a minimum while assuring resistance of the system to rot, rust and electrolytic corrosion.

SOLUTION: In new buildings, Carlon C, a polyethylene plastic tubing extruded by Carlon Products Corp., Cleveland, Ohio, was first laid on rough flooring and held in position with hooks while return bends were made. The material lends itself to bending in any position without tools and the hooks are merely a means of preventing creep while the operation is completed. Wire mesh was then placed over the tubing, and mesh and tubing were tied together at 2-foot intervals with binder twine. Positioning hooks were then removed and the entire system filled with water at about 40 lb pressure while 2½ inches of concrete were poured. For conversion of existing structures, tubing was laid over old floor surfaces and a similar tying and pouring operation completed the job.

RESULTS: Owing to flexibility, light weight and longer lengths of tubing, the installation was completed in approximately half the time normally required for construction of radiant heating slabs, and the number of fittings and joints was held to a minimum. Inertness of the plastic material gave assurance that electrolytic corrosion cannot occur within the slab.

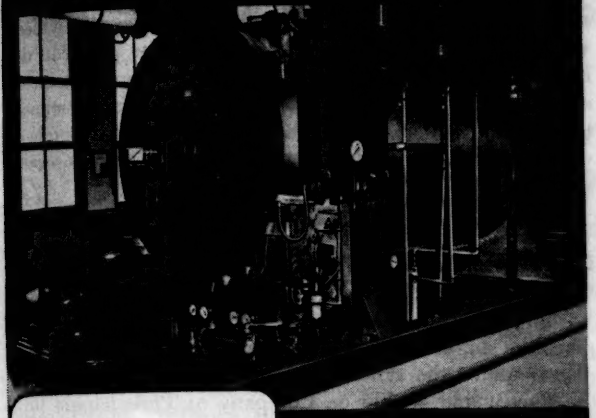
Pipe Insulation Poured Without Forms

PROBLEM: One of the difficulties of insulating underground pipe is the expense of either buying a particular insulated pipe section specially constructed for underground installation or erecting forms around the pipe to hold various kinds of insulating concrete. Both of these methods have their applications, but in some cases may be more expensive than the installation warrants with the result that piping may be either left exposed or badly insulated.

SOLUTION: A recently developed application of a petroleum mineral called Gilsonite appears suited for the insulation around pipes carrying hot substances. A form of the mineral called Gilsulate, a development of American Gilsonite Co., was used on a 6-inch steel line conducting 40 psi steam and a 2-inch condensate return line in a ditch 18 inches deep and 16 inches wide in the Intermountain area. Pipes were laid side by side and supported at approximately 12 foot intervals on reinforcing rods imbedded in concrete pads. Gilsulate in the form of dry granular material was poured around the pipes in the ditch without forms. Heat from steam and condensate acts on the material to form a waterproof glassy plastic cushion. The inner layer of material is bonded tightly to the pipe and a sintered zone exterior to this layer provides a waterproof impervious material of high insulating value. A third exterior layer of unconsolidated Gilsulate provides a load carrying cushion which is moisture resistant.

RESULTS: Labor required to handle the piping and insulation job and complete the backfill was less than ¼ of a man hour per lineal foot of the ditch. Cost of insulation was $2.45 per foot. Gilsulate provided insulation equivalent to 4 inches of 85% magnesium. Inspection of pipe after more than a year showed it to be free from corrosion although the soil is highly alkaline. Gilsulate is recommended for lines designed to operate in the temperature range of 100F to 220F.

$20,000 SAVED - This Steam-Pak generator installed in Stevens Linen Associates, Webster, Mass. saved $20,000 in operating during the first year of operation.



*Steam-Paks, the modern steam generators, operate automatically around-the-clock, furnishing steam or hot water as required. This automatic operation cuts costs, frees operator for other duties, and relieves the boiler "worries" of the plant engineer. Available in complete range of sizes from 15 to 300 hp. for high or low pressure steam or hot water. Fired with oil, gas, or a combination of oil and gas.

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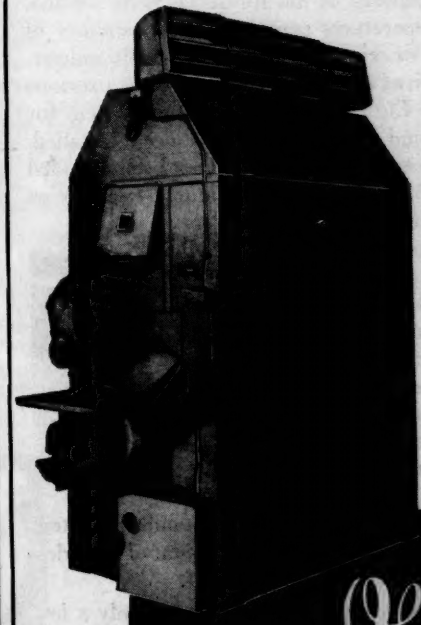

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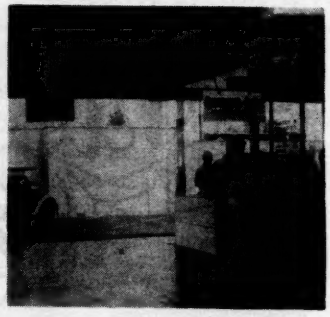
Blower Heaters Warm Out-of-Doors

PROBLEM: Ken's Drive-In Restaurant, Long Beach, California, depends on volume turnover in featuring its low-priced, quality hamburger sandwich. Damp, chilly weather has been known to diminish lineups of people waiting outdoors in light wraps to be served.



SOLUTION: Two 50.000 Btu Kilbury gas-fired unvented blower - type heaters were installed underneath a canopy from which they were suspended 30 feet apart and oriented so that the heat streams would meet at a common point near the head of the line and at the feet of the patrons. A warm core is created by convergence of the two warm air streams and the canopy acts as a lid to keep it from lifting.

RESULTS: Noticeably pleasant warm-up of air outside the immediate store front results. The prevailing wind happens to be favorable to the installation, but even with moderate wind shifts considerable benefits are observed to remain. The arrangement promises to become more than a fad since it was quickly adopted by three other competing drive-in restaurants.

Individual Air Outlets Cool Laundry Workers

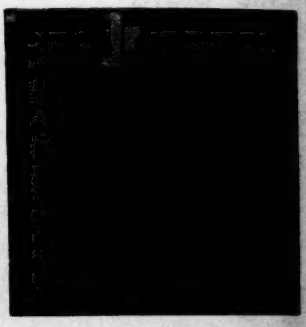
PROBLEM: In the laundry of the Roosevelt Hotel, Waco, Texas, summer temperatures combined with humidity of the operation make working conditions practically unbearable. High turn-over of laundry workers became a serious problem. While the Chrysler Airtemp cooling system for the dining rooms and public spaces had been installed, the laundry, located in the basement, had not been included in plans for the 225 ton system. When laundry service as well as guest service began to suffer as a result of employee turnover, management decided to try to cool the laundry. The load on the space included nine laundering machines of various types, in addition to hot water heaters, with the substantial latent heat characteristic of such installations. No standard system would do the job without a tremendous amount of remodeling and rearrangement of the laundry itself.

SOLUTION: Fortunately, the laundry is located only a few feet away from the compressors providing refrigeration for the hotel air conditioning system. Capacity of the system was such that considerable excess cooling was available to engineers working on the laundry problem. It was decided to cool the laundry in nine separate zones each of which is actually only 6 feet square or so of floor space occupied by each of 9 employees. Kelly Refrigeration Company, the installing engineers, designed a cone outlet resembling a large galvanized circular trough about 3 feet in diameter which directs air directly downward from a plenum chamber in the ceiling. A simple damper is provided by means of a projecting handle which can be operated by each employee to his own taste. Each unit can deliver 500 cfm of cool air at approximately 75F.

RESULTS: Each employee operating a machine is provided with an envelope of cooled air. There are no problems of headaches or excessive perspiration, such as caused several employees to faint during the previous summer. Personnel turnover is reduced to a minimum and a vastly higher output ratio has been achieved according to the Roosevelt owners.

Orchids Thrive on Warm Air Heat

PROBLEM: At the greenhouse of orchid grower Frank Vatinno of Andalusia, Pa., it became necessary to replace the standard heating system consisting of pipe coils placed under the growing beds. Mr. Vatinno called on the Parent and Kirkbride Company of Philadelphia for recommendations. He described the greenhouse as 90 feet long, 15 feet wide and 10 feet high at the peak. Growing conditions for orchids in northern states require temperatures of 62 to 65F, with plenty of air and moisture.



SOLUTION: The Parent and Kirkbride Company recommended that the pipe coils be abandoned and a direct fired Thermobloc space heater, manufactured by the Prat-Daniel Corp. of South Norwalk, Conn., be installed. An oil-fired unit of 200,000 Btu per hour capacity was installed in a central location in the greenhouse. Louvered diffusers in the furnace bonnet send air streams out over the tops of the plants maintaining velocities of 25 fpm at either end of the greenhouse. Air is returned along the floor line. The unit is equipped to humidify as well as heat the air.

RESULTS: Checking back for Parent and Kirkbride, Ralph Mizener, sales engineer, reports that operation through their 1951-52 heating season showed lower operating costs. In addition to savings on fuel costs, capital investment in the equipment itself was considerably less than would have been required for traditional hot water equipment. Unexpectedly, the number of man hours required to tend the plants was reduced appreciably. Whereas the original system tended to dry out the growing beds rapidly, making frequent watering necessary, the new heater and automatic humidifier reduced evaporation so that watering is now required only once a day. One cold windy night in February with the outside temperature at 10F, the door of the greenhouse blew open. Ordinarily this could have been a catastrophe and the entire stock wiped out. Instead, the furnace, answering the continuous call for heat, fired all night and confined the loss to fifty plants in the immediate vicinity of the open door. Mr. Vatinno plans to install Thermobloc heaters in his remaining six greenhouses so that, as he says, he can sleep at night instead of keeping one eye on the thermometer outside his bedroom window.

PRODUCT INFORMATION SERVICE

Use the postage-free postcard below for further information on:

- **News of Equipment and Materials**
- **New Catalogs**

Circle the Item Numbers in which you are interested and print clearly your name and address with title.

NEW CATALOGS

CENTRIFUGAL PUMPS
Bulletin ET-452, giving detailed information on its series 1531 Uni-Built centrifugal pumps, is issued by Bell & Gossett Co., Morton Grove, Ill. The new remite leakproof seal on these pumps virtually eliminates leakage which occurs when conventional packing glands are used. Made of a composition of materials, the seal is also wear-proof, corrosion-resistant and self-lubricating. ..... **Item 41**

GAS HEATERS
A complete revision of literature to include new designs and data of its line of gas heaters has been prepared by Reznor Mfg. Co., Mercer, Pa. Heading the list is a 20-page general catalog, GN-52, in which the line is classified into the four types of heaters which it manufactures, each of which is completely described. ..... **Item 42**

TEMPERATURE INDICATOR-CONTROL
An eight-page catalog section No. 55, illustrating and describing its new Thermo Electronic signaling temperature controller is available from Thermo Electric Co., Inc., Fair Lawn, N. J..... **Item 43**

UNIT HEATER LAYOUTS
A new catalog A-365, covering its unit heaters is announced by United States Radiator Corp., Detroit, Mich. It covers heater location, various types of unit heater wiring diagrams, steam pipe sizes, capacity data, and all necessary technical information for making a unit heater layout. ..... **Item 44**

AIR CONDITIONER CAPACITIES
Bulletin AC-504, a new catalog on Recold multi-zone air conditioners has been published by Refrigeration Engineering, Inc., Los Angeles, Calif. The bulletin lists air conditioners in capacities up to 24,000 cfm. ..... **Item 45**

SUBMERSIBLE SEWAGE EJECTOR
Bulletins SE-860 and SE-870, describing features, ratings and capacities of its submersible sewage ejector and illustrating various methods of application have been issued by Weil Pump Co., Chicago, Illinois. ..... **Item 46**

DAMPERS, DUCT ACCESSORIES
An 8-page catalog of its direct and remote damper controls, relief and multi-blade dampers and related equipment has been issued by the Young Regulator Co., Cleveland, Ohio. Catalog includes the company's comprehensive line of this type of equipment. ..... **Item 47**

INDUSTRIAL CORK PRODUCTS
A completely revised bulletin on its industrial cork products has been published by Dodge Cork Co., Inc., Lancaster, Pa. Information is included on the structure of cork, natural cork products, cork compositions, physical characteristics and typical products made from both natural cork and cork compositions. This 4-page illustrated bulletin has tabular data on the density, tensile strength, compression and coefficient of friction of natural cork. The bulletin also gives physical properties, characteristics and uses, sheet sizes, and thicknesses.... **Item 48**

PRE-SEALED INSULATED PIPE
A new bulletin No. 6c on pre-sealed insulated pipe for underground and weather-exposed piping systems conveying hot or cold liquids or gases has been published by Durant Insulated Pipe Co., Palo Alto, Calif. The bulletin lists applications, special features, design, and specifications. ..... **Item 49**

MOTORS AND REDUCTION GEAR
A new price book has been issued by U. S. Electrical Motors, Inc., Los Angeles, Calif., and incorporating price changes and other information including price reductions approximately up to 20% on some equipment, new ratings on Varidrives with right angle Syncrogear units, on large Varidrives and on single phase Varidrives. Material includes discount schedules, new index tab and a new totally-enclosed explosion proof motor bulletin. ..... **Item 50**

PROPELLER FANS
Fan Catalog F-52 has been issued by M & E Mfg. Co., Indianapolis, Ind. It describes the company's line of propeller type exhaust fans, how to select them, and shows how they are built. This 12-page catalog covers the complete line of heavy duty exhaust fans ranging from 12 to 48 inches in size and delivering from 900 to 38,000 cfm. Also described is the company's line of window mount units, duct mounted exhaust units, roof ventilators, automatic shutters and exhaust piping. ..... **Item 51**

FIRE PROTECTION EQUIPMENT
Catalog 49 entitled Hose Brass Goods has been published by W. D. Allen Mfg. Co., Chicago, Ill. Containing 66 pages, the catalog lists the diversified and comprehensive line of cabinets, brass goods and accessories used in connection with fire protection equipment..... **Item 52**

GUIDE TO ALLOYS AND FLUXES
A buyers guide to alloys and fluxes for welding, brazing, soldering, tinning and cutting, is issued by All-State Welding Alloys Co., Inc., White Plains, N. Y. The purpose of this guide is to show in addition to the usual products in this catalog, what is recommended for the specialized problems such as the joining of aluminum to copper, joining of nichrome to copper, uses and applications of the 12 silver solders available from the company, and similar information. ..... **Item 53**

CEILING OUTLETS
Catalog 201 has been issued by W. R. Carnes Co., Verona, Wis. and devoted to its Model BR and BRS ceiling outlets. These are adjustable multicone ceiling outlets said to be simple to adjust for all air patterns. Complete descriptions are accompanied by engineering details and performance data. Company has also issued Catalog 301 devoted to its Model CR ceiling outlets which are adaptable to flush ceiling or exposed duct installation and with hinged vanes inside the diffuser to give control over the volume of air. This also includes engineering and performance data..... **Item 54**

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HEATING AND VENTILATING
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READERS' SERVICE DEPT.

STEAM TRAP BULLETIN

A revised edition of its Bulletin 213, a condensed catalog on steam and air traps, is announced by Armstrong Machine Works, Three Rivers, Mich. It contains a sequence of diagrams explaining the operating principle and design features of the maker's inverted bucket traps. Prices, physical data, and other details concerning cast semi-steel steam traps, forged steel steam traps, and ball float air and air relief traps are included. Data are given on internal check valves, blast traps with thermic vents, traps with built-in strainers, and Y-type strainers. A full page capacity chart shows actual continous discharge capacities for all sizes of traps at various pressures. Two pages are devoted to calculation of condensate loads for various equipment... **Item 55**

ALL TYPES METAL HOSE

A 32 page illustrated catalog, No. CMH-130, on all types of its metal hose is released by Flexonics Corp., Maywood, Ill. It covers the full range of the company's Rex-Weld corrugated flexible metal hose, convoluted hose types, and stainless steel flexible metal hose. Complete specification data are given. Also covered are coupling types, special assemblies, and installation..... **Item 56**

INSULATING MATERIALS

Industrial Insulations is the subject of a new catalog published by Baldwin-Hill Co., Trenton, N. J. This 20-page illustrated catalog describes insulating materials which cover the complete temperature range from —150 deg. to 1800 deg. Insulating cement, block, blanket, felt, and pipe covering are a few of the products shown. Complete with thermal-conductivity graphs and heat loss charts, this catalog also shows list prices subject to trade discounts. Brief application descriptions together with typical uses, sizes, packaging, and densities are also covered. ..... **Item 57**

GAS COMBUSTION

The story of gas combustion and the growth of a large manufacturing organization built around its diversified applications is told in a new booklet entitled Heat in Harness, produced by Surface Combustion Corp., Toledo, Ohio. It is designed particularly to tell the aircraft gas combustion industry about the technology and engineering which are embodied in today's aircraft heaters. Actually, it succeeds in accomplishing much more. The fields of heat application, ranging from fundamental studies in the research laboratory to the furnaces of the steel mills, are presented... **Item 58**

VACUUM CLEANING TUBE

A 4-page folder has been issued by H-P Products Inc., Louisville, Ohio, devoted to the company's line of VacuFlo standard steel fittings and tubing for vacuum cleaning systems and conveying lines. This tubing and accompanying fittings are available in a variety of sizes ranging from 2⅛ inches outside diameter to 3½ inches..... **Item 59**

DUST FILTERS FOR PROCESS

Bulletin 102, describing in detail its new Dynaclone dust filter, designed primarily for the continuous process industries where uniform suction at all dust points is essential, is issued by The W. W. Sly Mfg. Co., Cleveland, Ohio. It gives complete engineering data on this equipment, including details of construction, principle and application. Included are hints on the engineering of dust control problems, as well as other useful engineering aids. ..... **Item 60**

COMPRESSOR LUBRICATION

A 48-page handbook entitled Refrigeration Compressors and Their Lubrication has been issued by Socony-Vacuum Oil Co., Inc., New York, N. Y. The entire booklet is devoted to a simple and exceedingly well illustrated explanation of refrigeration lubrication from a technical standpoint. ..... **Item 61**

COATING THICKNESS GAGE

A six-page folder describing the theory and operation of the Coatingage Model 600 is available from Branson Instruments, Inc., Stamford, Conn. This portable instrument is used to measure the thickness of non-magnetic coatings on magnetic bases, and to detect pin-holes in non-conductive coatings on conductive bases. One of the most important applications for this versatile instrument has been the examination of corrosion-protective coatings for thickness and film continuity. ..... **Item 62**

INSULATION BROCHURE

The Ultralite duct insulation brochure is issued by Gustin-Bacon Mfg. Co., Kansas City, Mo. One section in the bulletin illustrates the use of the Bostitch T5-8 outward-clinch staple tacker used with success to apply the insulation on the job. Fifteen pages long and profusely illustrated with How To . . . data and pictures, the brochure explains and demonstrates the thermal and acoustical qualities of the company's glass fiber insulation. Bulletin details when to use this insulation, and in what densities and thicknesses, as both duct insulation and duct liner. Accessory materials, tapes, stapler, adhesives, etc. used to apply it also are treated, as well as facing types available and where to use them. Step-by-step procedures are given... **Item 63**

DRAFT CONTROL

A complete new catalog is issued by Field Control Div., Mendota, Ill., covering its barometric draft controls for oil and coal fired residential and commercial heating equipment and gas-fired commercial installations. It gives a complete description on each control including sizes, dimensions and shipping weights. Controls illustrated include the Type M for automatic heating plants, Types R and Scotty for space heaters, ranges and water heaters, Barochek for hand-fired furnaces and boilers, and the new M-G control for gas-fired industrial installations. **Item 64**

GLASS INSULATING WOOL

Form WB-1, a 4-page folder on its Microlite glass fiber insulating wool has been published by Glass Fibers, Inc., Toledo, Ohio. This wool is a low density, resilient insulating material with high thermal efficiency and sound absorption characteristics for buildings, equipment, appliance, industrial and marine and other appliances. Product is fully described and tabulations of properties given. ..... **Item 65**

48-PAGE UNIT HEATER CATALOG

A new 48-page Herman Nelson unit heater catalog, Bulletin 3570, describing both vertical and horizontal shaft units, is now available from the Heating and Ventilating Department, American Air Filter Co., Inc., Louisville, Ky. The booklet gives a description of component parts and dimensions for both style heaters, expanded steam and hot water capacities are included. Steam capacities are now tabled up to 50 psi at 50, 60, or 70 deg. entering air. The hot water tables include capacities at 180 and 200 deg. A fourteen page section is devoted to the selection and application. Included are detailed mounting height tables, including diffusers, quietness rating tables, a sample heat calculation sheet, and detailed description of unit selection and application. A two page section on motor controls showing typical wiring diagrams and a section on piping are included.. **Item 66**

THERMOSTATIC REGISTER

A 4-page catalog in color has been issued by The Dole Valve Co., Chicago, Ill., devoted to its automatic register for forced warm air heating systems. This register is equipped with a built-in thermostatic control that adjusts the damper to let in the right amount of warm air to maintain the desired temperature. Catalog shows details. ..... **Item 67**

MOTORS AND CONTROLS

A 4-page, quick-reference bulletin No. A-2703, describing and illustrating its principal products, is issued by Reliance Electric & Engineering Co., Cleveland, Ohio. It gives capsule digests of the company's a.c. motors from ¾ to 300-hp.; heavy-duty Type T d.c. motors from ¾ to 1000-hp.; the all-electric adjustable-speed drive for a.c. circuits, from ¾ to 300-hp.; electronic controls and regulators for this motor-drive system; and motor-generator sets, generators, and rotating-type regulators. ..... **Item 68**

MEDIUM-SIZE BOILER

Catalog 88, which illustrates and describes the company's Square-Heat boiler for oil, gas or stoker firing and includes four new larger sizes, is issued by Kewanee-Ross Corp., Kewanee, Ill. It contains a complete description of quality features, as well as listing ratings, dimensions, equipment and trims.. **Item 69**

PLEASE SEND US MORE INFORMATION. Circle below item numbers on which you wish further information.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
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31	32	33	34	35	36	37	38	39	40
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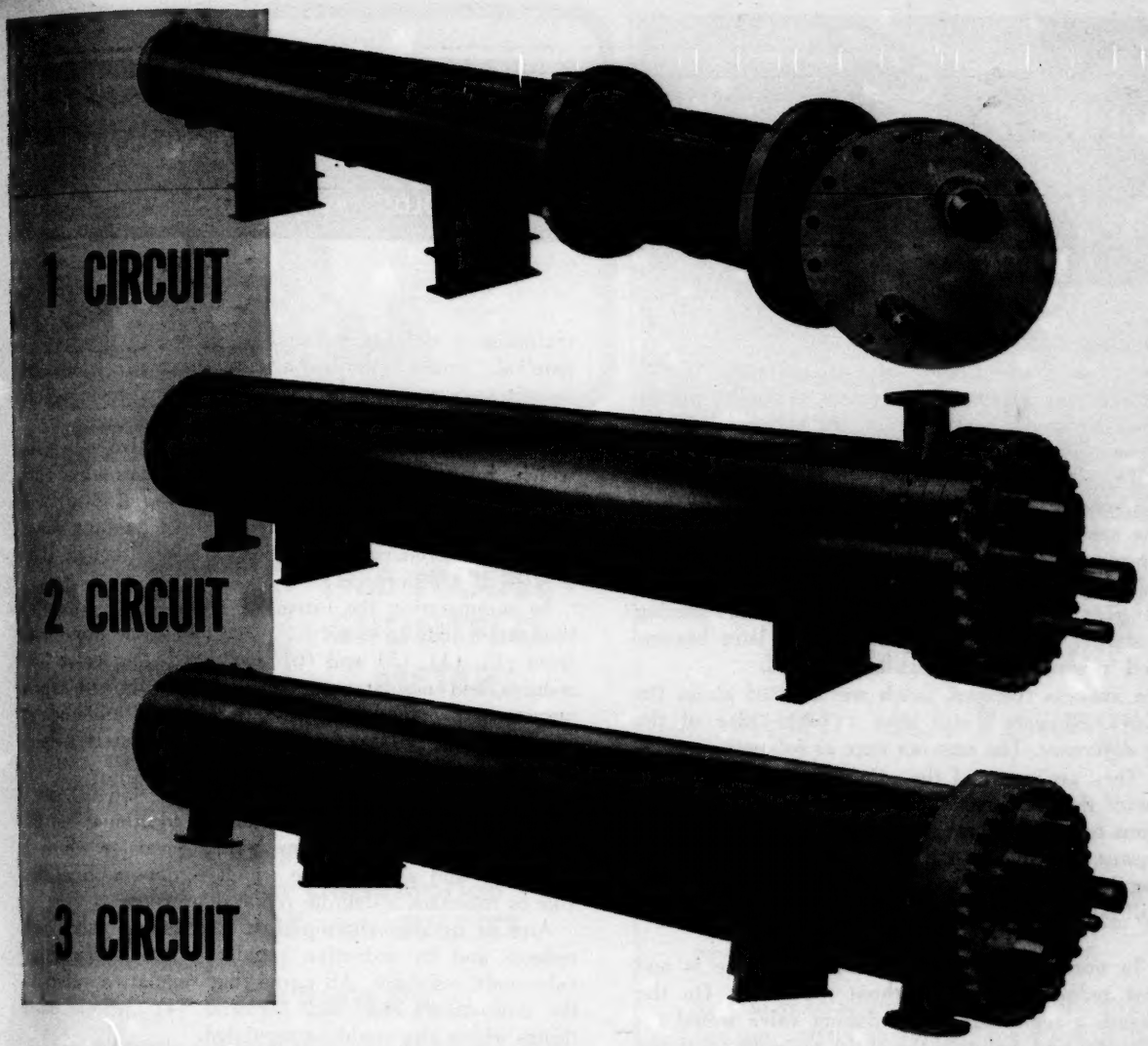

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even out fluctuating loads

Here is the sure answer to the problem of fluctuating cooling loads—supplied by p-k. One, two or three circuit p-k Freon Coolers are specifically recommended to match your load. They are the practical, logical, economical answer to uniform cooling needs. Each type is designed to insure maximum heat transfer efficiency under the particular load conditions specified for the job. Regardless of weather conditions—hot, cold or moderate—p-k Freon Coolers will constantly maintain optimum temperature differences and high refrigerating efficiency.

For the best in value and dependable service—plus dependable operating efficiency—it will pay you to know all about p-k Freon Coolers. Write today for catalog No. 101 covering size ranges, engineering tables and other important data. Send for it now, for immediate use or later reference.

1906

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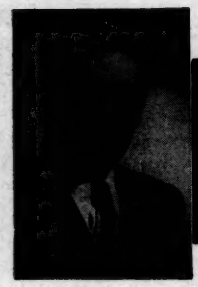

Experience is my Classroom

By T. W. REYNOLDS

• REDUCING AND REGULATING VALVES

Several years ago I had some correspondence with several reducing valve manufacturers as to the precise difference between a pressure reducing valve and a pressure regulating valve, since what is called a reducing valve in one catalog may be designated as a regulating valve in another. This information was deemed necessary to write specifications, for the mere mention of a pressure or regulating valve, without fixing all the things it is to do, is apt to lead to misunderstanding and controversy regarding the guarantee. I believe that reducing valves started out as reducing valves and later became qualified in some cases as regulating valves.

From answers received, much was learned about the difference, although I still have a vague idea of the *precise difference.* The answers were as follows:

(1) They are one and the same thing. The primary purpose of the valve is to reduce a pressure and at the same time to keep this pressure steady or regulated. The very means of reducing the pressure gives at the same time regulation, because any changes in the initial pressure will be reduced in magnitude in the delivery pressure.

(2) In normal terminology a reducing valve is one that just reduces pressure without regulating. On the other hand, a regulating and reducing valve would reduce pressure and maintain the outlet pressure relatively constant regardless of changes of flow or changes of inlet pressure.

(3) A pressure reducing valve maintains constant reduced pressure, whereas a pressure regulating valve is broad terminology. A regulating valve may regulate back pressure, reduced pressure, or level of a liquid.

(4) A reducing valve controls downstream pressure. A regulating valve has a more general use. It may imply control of either the upstream or downstream pressure, or designate the control of some other variable, such as temperature.

(5) So far as our knowledge goes the terms "pressure reducing valve" and "pressure regulating valve" have been used interchangeably. For industrial applications we are under the impression that a regulating valve is the term applied to a valve when used for close control or regulation of a given pressure. In the latter instance, the term would apply to valves which are specially designed to hold the pressures within very close limits.

(6) The precise difference between a regulating valve and a reducing valve is in the interpretation of the words "regulating" and "reducing." Usually, however, a reducing valve in the true sense is a regulating valve, although it is not always true that a regulating valve is a reducing valve. For example, a steam pump governor is a regulating valve, nevertheless it neither controls nor maintains a definite reduced pressure. Furthermore, a gate valve could be termed a regulating valve if adjusted to suit various conditions, but surely it does not automatically maintain a definite reduced pressure.

I would, therefore, define a reducing valve as a valve which, by reason of its construction, maintains automatically à set reduced pressure regardless of flow conditions. The terms "reducing valve" and "regulating valve" are used interchangeably by the trade, although there actually is a difference.

In summarizing the foregoing comments by implication rather than by exact wording, I gain the impression from (1), (4), (5) and (6) that a reducing valve both reduces and regulates to which (2) is in substantial agreement provided it is called a reducing and regulating valve, but (3) says a reducing valve merely reduces and no more.

As to a regulating valve, (3), (4), (5) and (6) say it can only regulate, and (5) makes an additional but important point about a steam pump governor which is automatic and a gate valve which is not—with neither able to maintain a definite reduced pressure.

And so by majority opinion, a reducing valve both reduces and by reduction regulates, and a regulating valve only regulates. All agree that regulation refers to the downstream side and (3) and (4) include other things which also could be regulated.

• HEATING AIR CONDITIONED ENCLOSURES

Applications where heating is deliberately introduced into air conditioned enclosures are growing in number and kind. One learns of hot pipes in floors to keep the feet warm, or to prevent the floor heaving due to frost; of spot heaters; of electric blankets or a group of lights in a refrigerator, By now we are long familiar with reheating coils at the main apparatus, or in ducts as boosters for zoning.

The spot heater referred to was an electric heater which a woman brought to her work in an air conditioned office. She uses it whenever the sun is not on her side of the building. And why not? Such use or non-use does satisfy the individual as to temperature, the same as systems have boosters in ducts? Tonnage of refrigeration will increase, but the engineer will be freed of many complaints.

In World War II, at the Remington Arms Plant, the writer installed lights in a refrigerator maintaining test bullets at the temperature required in an adjacent firing range. The refrigerator kept the temperature down, the lights prevented overcooling. Time lag of controlling thermostats were overcome. The bullets were kept in a small container in the refrigerator.

(*Continued on page* 140)

NEW STEAM METER

BUILDERS 1952 MODEL SHUNTFLO METER

—FOR STEAM, AIR OR GAS

Gives you answers to steam consumption in POUNDS, not GUESSES.

FEATURES

- **Strengthened rotor shaft to withstand slugs of condensate or other liquid, or sudden changes in pressure**
- **Simplified rotor mechanism — efficient, longer lasting, easier to repair or replace**
- **Streamline damping chamber for more uniform cooling**
- **All Meehanite iron body casting**

Builders Shuntflo Steam Meters are available in two styles: Model SMKS for 2" to 14" lines — Model SMDH for 1" and 1½" lines. Send for descriptive Bulletins 400-F1 and 400-F2. Builders-Providence Inc. (Division of Builders Iron Foundry), 469 Harris Ave., Providence 1, Rhode Island.

See

. . . the new 1952 Shuntflo Meter at the Power Show — New York, at Booth #93.

BUILDERS PROVIDENCE *Instruments*

BIF INDUSTRIES — BUILDERS

for recording, indicating, and controlling flow, liquid level, pressure, and weight. Chlorinizers — chlorine gas feeders.

Convenient make-up, symmetrical runs with "K" Fittings

Due to chamfered entrances and clean threads, "K" screwed fittings are easy to start and draw up. "K" flanged fittings have accurately milled faces and exactly spaced bolt holes, making them convenient to connect. These are advantages which save time and assure tight joints.

Skillful molding and precise machining give "K" Fittings correct angularity, the essential factor of symmetrical runs.

Since we manufacture fittings exclusively, our business depends upon making them satisfactory to plumbing contractors and plant engineers. The success of our efforts is indicated by the numerous plant expansions which have been required to supply the demand for "K" Fittings.

It will pay you to order fittings from distributors who handle the Kuhns line bearing the "K" trade-mark.

K CAST-IRON FITTINGS

3000 SHAPES AND SIZES

THE KUHNS BROTHERS COMPANY

Dayton 1, Ohio

A department store uses a home freezer to display an electric blanket inside and impress one with capacity of the blanket to overcome below freezing temperatures. The shopper is urged to place a hand inside the blanket to note its warmth.

Radiant heating by pipes in the floor is sometimes used in cold storage rooms when these places are maintained at freezing temperatures. Employees who stack and load products in such rooms must be kept comfortable. This is done without any appreciable affect on the room temperature.

Snow melting systems have wandered far from their original purpose, especially so with the greater development of anti-freeze solutions. They serve from the melting of snow to the drying up of rainfall to prevent tracking mud into stores. They are now found buried in the concrete base under the insulation of floors in cold storage plants and freezing tunnels. Moisture by vapor pressure or otherwise finds its way to the ground and concrete base where it freezes and heaves the floor, sometimes as much as 12 inches. Fast freezing and repeated upheavals eventually crack the expensive insulation and allow more moisture to move below.

More insulation could be used to overcome such conditions, but it has been found cheaper to use a snow melting system, that is, coils which contain a warm anti-freeze solution. In one installation, heated fuel oil is forced through the coils by a circulator. Normal operation of a cold storage plant may range from 10 to 30F below zero. One plant operates at 200F below zero.

• MAKING A STEAM TRAP "MORE BETTER"

Lewis Smith of the C. A. Dunham Co. writes, "I always look with interest in HEATING AND VENTILATING for the section you write to see what your fertile imagination has produced. In the May issue you relate some experiences in China of my friend Harold Alt. I arrived in China as he left and in visiting a hospital noticed that our thermostatic traps had an unfamiliar solder spot on them. Upon inquiry the native chief engineer said that he had punched a small hole through each disc to inject ether after which he closed the hole with solder. This is a characteristic of the natives who always want to do everything, as they say, 'more better'. I never did find out the result of what he did and later in telling the tale to Mr. Dunham he just laughed and no change was made to our factories to make them 'more better'. In closing, I just want to let you know that I am interested in your varied experiences."

• ICE LOWERS A MACHINE IN PLACE

No doubt some of us have heard the story of the workman who fell into a pit and who was removed, according to the teller, by (1) riding a plank after sufficient water was turned into the pit to float him out, or (2) by gradual earth fill of the pit so the worker could finally walk out. This is a case of filling a pit to get something out of it. However, filling a pit to get something down into the pit is quite another matter. Although the following incident is not typical of the usual problem encountered in construction work, it is of interest to show the ingenuity occasionally displayed to meet new situations as they arise.

In the case in mind, a machine required placement in a newly constructed pit. Pit clearances provided rather a snug fit for the machine and no rigging had as yet arrived for lowering the apparatus in place. It was near the close of the day and the riggers wanted to be through and on their way. A mere laborer provided the answer. He suggested completely filling the pit with ice. This was done and the machine then placed on the ice foundation. By morning the ice had melted and the machine was found resting with its base at the bottom of the pit.

• HEATING FUEL OIL

Many a discussion arises as to whether or not the oil in a particular storage tank requires heating or at least partial heating when starting up after an idle period. It is often said that the oil in either a small or large tank (buried or vaulted) does not require heating when often filled, particularly so because the oil is delivered hot.

Oil, of course, will not lose much heat in any tank buried outdoors below frost line or vaulted inside of a building, unless (1) the oil is stored for a long time, (2) the tank is in ground water, or (3) there is no backfill between the tank and vault. Oil next to the metal of the tank may shortly cool, but in doing so the oil congeals and thermally insulates the warmer oil within the insulating envelope.

This reasoning is all good, especially for the past, but heavy oils are becoming heavier with higher pour points and viscosities. So it may well be that some fuel oil installation of a type, location, or condition which formerly proved satisfactory without heating the oil may now require it because of current use of a heavier grade of No. 6 oil, or due to change in operating conditions.

The main body of oil in the tank itself needs only enough warmth to settle to the inlet of the suction line. Settlement can be slow because the area through which this takes place is large relative to the area of the suction pipe; but at the suction inlet there must be a sufficient and higher temperature to cause the oil to enter the suction pipe and to flow therein to the burner.

• COMBINED TEMPERATURE AND PRESSURE RELIEF VALVE

The combined temperature and pressure relief valve for domestic hot water tanks and heaters is no longer exactly new. However, there is still a greater realization for its need.

The hot water boiler and the domestic hot water tank and heater all contain hot water, but in the boiler, temperature and pressure are more limited and better controlled. Unfortunately, in domestic water systems the water and air are being continually renewed and this makes the storage tank and heater more susceptible to corrosion. High water pressures and water hammer may also exist to rupture a tank and suddenly release what may be aptly called explosive water since such water instantaneously gives up the large amount of heat stored above the boiling point at atmospheric pressure.

The combination thermostatic valve automatically serves to remove sufficient over-heated water and to admit new cold water to keep the remaining water from reaching an xplosive temperature in the event that the water from the system is accidentally released to the atmosphere.

AUER GRILLES

Heating, air conditioning and plumbing contractors and engineers receive expert service from Auer on perforated metal grilles. The Auer line includes a variety of attractive designs for all purposes—air conditioning, ventilating, radiator enclosure, or concealment. We furnish almost any size, to your order, and in all available materials. Order Auer grilles by name and number. Send for bulletin showing all designs.

THE AUER REGISTER COMPANY

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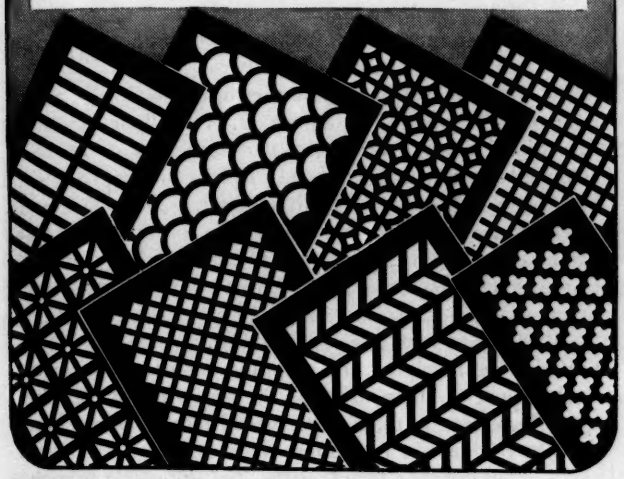

MOISTURE'S NO PROBLEM

MUCKLE VENTS

chase out foul, wet air!

- Good looking
- Fit any roof
- Easy to install
- Motor out of line of air flow — for better performance in moisture filled air.

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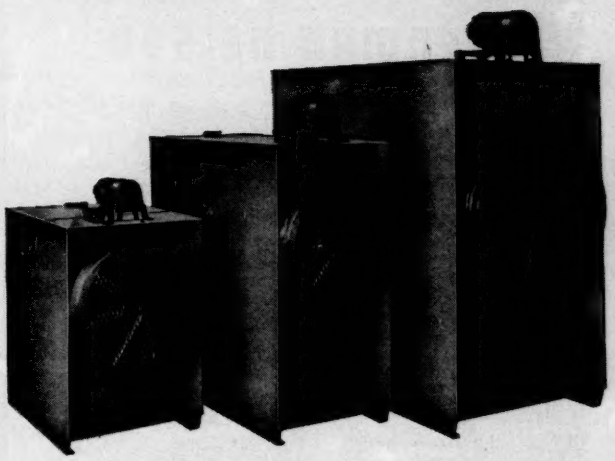
COOLING TOWERS



20-Year Guarantee!

ON THE WETTED DECK SURFACE

For top efficiency in water conservation and re-cooling—specify the "battleship strength" of HM Cooling Towers. Hailed by refrigeration users everywhere, HM units provide 20 years of foolproof performance—made possible by the processed wetted deck surface of chemically treated special Koppers wood —guaranteed against rotting, proofed against fungi growth. It's the most efficient cooling tower construction on the market. Available in all sizes—5 thru 50-ton capacity.

HOUSING—10 gage sheet steel with 3 coats Bitumastic lining.

FAN & DRIVE—Stainless steel 8-bladed fan, stainless steel shaft.

WATER DISTRIBUTION—Gravity-type pan eliminates extra pumping head.

Carried in stock by leading wholesalers everywhere

HM Halstead & Mitchell

OFFICES: BESSEMER BUILDING • PITTSBURGH 22, PA.

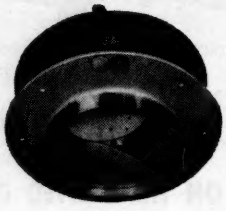
A unit heater for every need

from

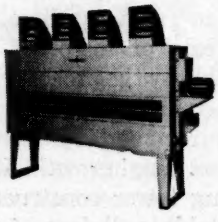
HERMAN NELSON

Get your copy of this new Unit Heater Catalog. Free for the asking.

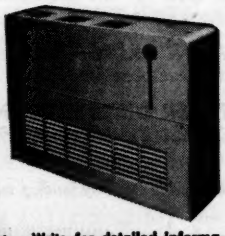
Vertical Shaft-Propeller Fan Type Unit Heater— ***especially suited to buildings with high ceilings up to 50 feet.***



Centrifugal Fan Type Unit Heater— ***for efficient heating and ventilating of large industrial spaces.***



De Luxe Unit Heater— ***an attractive, quiet operating unit designed for stores, offices, churches, etc.***



Write for detailed information about any type Herman Nelson Unit Heater to Dept. HV-11.

AAF herman nelson

HERMAN NELSON

DIRECT-FIRED HEATERS

(*Continued from page* 128)

The new 8¼ acre warehouse of the S. S. Kresge Co. at Fort Wayne, Indiana, is a particularly spacious building, designed to be architecturally attractive as well as functional. It was planned to have it equipped with adequate heating and ventilating.

• **ROOF.**—In the construction of the roof, a mineral product was used with portland cement to form a very light weight surface. This concrete, 4½ inches thick, was poured in place on top of galvanized, corrugated, steel sheets. After pitch and slag roofing was applied, there resulted a permanent, fire resisting roof with fine insulation qualities (U factor—.13).

• **WAREHOUSE.**—The warehouse building itself has a floor area of over 300,000 sq ft. Two floor mounted direct-fired heaters are located along each of the four side walls, and a ninth is positioned in the center of the building adjacent to the railroad track well. Each heater discharges its output into short runs of ductwork that extend along the wall on either side of it. This is arranged to create a blanket of warm air over the entire area without running a duct network throughout the building.

• **WINGS.**—At each end of the building, wings have been built for the receiving and shipping departments, respectively. Each of these areas is 90 feet wide by 225 feet long. Two heating units were placed in each wing. Here, too, the design was to blanket the work area with warm air. For 0F outdoor temperature, the units were to maintain a uniform temperature of 65F.

• **ENTRANCES.**—Frequent opening and closing of large doors in the receiving and shipping departments, plus the fact that ceilings in these areas are 19 feet high, required the special attention of Kresge engineers. To maintain comfortable temperatures in these areas, two horizontal, overhead heaters were employed in each zone. Thus, the temperature drop caused by incoming cold air, when the doors are opened, is quickly overcome by the build-up of warm air discharged directly into the area by the heaters.

• **CREDITS.**—The self-contained, direct-fired space heaters used are Dravo Counterflo heaters. General contractors were Hagerman Construction Corp., Ft. Wayne. The heating contractor was Industrial Piping and Engineering Co., Ft. Wayne.

• Otto Janssen has been appointed manager of spare parts sales of AiResearch Manufacturing Comp., Los Angeles, Calif., reporting directly to Burnham Adams, sales manager. Mr. Janssen has been with the firm for six years, initially as a sales engineer. He was supervisor of spare parts sales and then became assistant manager of the customer service department before moving up to his new post.

• Civilian health facility construction estimated at $781 million was put into place during fiscal 1952. It was the greatest such year in history for the nation's health construction, according to a USPHS report.

...FROM

HERMAN NELSON

The operator of this warehouse insured economical, dependable heating by installing 72 Herman Nelson Horizontal Unit Heaters.

These rugged, dependable units provide the efficient solution to the heating problems of most commercial, institutional and industrial establishments. Features, designed in the units, provide a quietness and durability unequalled in the industry.

There are 18 sizes of Herman Nelson Horizontal Unit Heaters. B.T.U. output ranges from 25,000 to 350,000 per hour. All units operate on steam or hot water. Single or two speed motors are available in either 115 or 230 volts, AC or DC.

Herman Nelson Unit Heaters are ahead of the field because constant engineering development and research plus functional design have earned this position—the result of 46 years of experience in the production of quality heating and ventilating equipment.

SUPERIOR IN *BOTH* HEATING ELEMENT AND FAN DESIGN

Herman Nelson Unit Heaters are suitable for the smallest service station or the largest factory. Each unit does an extremely efficient job of heat transfer and distribution. This is because *both* heating element and fan are unique in design. Study the points listed on the left and you'll see that every part has been carefully engineered to do its particular job best.

AAF herman nelson moline illinois

HERMAN NELSON

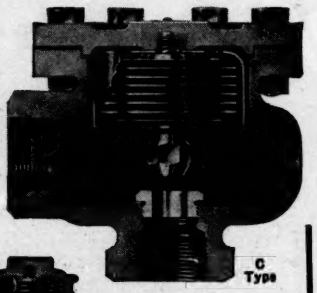
Division of **AMERICAN AIR FILTER COMPANY, INC.**

MOLINE, ILLINOIS

NICHOLSON TRAPS

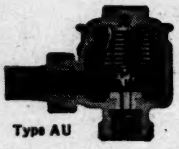
STOP TEMPERATURE FLUCTUATION LOSS

The unusual effectiveness of Nicholson traps in discharging air as well as condensate was again proved recently by a large maker of molded products. Costly temperature fluctuation of the presses was eliminated by Nicholsons. Also widely used for such critical applications as jacketed kettles. 5 types; for process, heat, power; sizes ¼" to 2"; press. to 250 lbs.



C Type

Type AHV

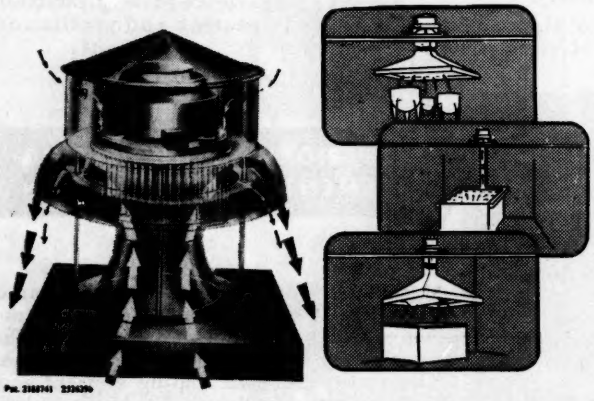


Type AU

BULLETIN 152
199 Oregon St.,
Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.
TRAPS · VALVES · FLOATS

IT PAYS to know these Facts about Exhausting Moisture and Fumes



CERTIFIED RATINGS: Gallaher Air Vans are tested by an independent laboratory — a test of the whole unit *not* just the fan wheel. You can be sure of Gallaher performance data — it's tested *not* interpolated.

SAFE MOISTURE AND FUME REMOVAL—Motor out of the air steam with the exclusive patented air seal off to make it certain. How safe? Gallaher units are safely used for ether and air concentrations *without* explosion proof motors.

EFFICIENT: SCROLL EFFECT designed into the unit and exclusive with Gallaher. Research tests show that efficiency against *even normal* static pressures is not possible without it.

STRONG: We invite comparison with any comparable unit. Our specifications are *published* and available by asking your local Gallaher representative or writing Dept. A, 4108 Dodge Street, Omaha, Nebr.

Capacities 150-11,000 CFM; Static Pressures to 1¾"

The GALLAHER Company
Omaha, Nebr. Owatonna, Minn.

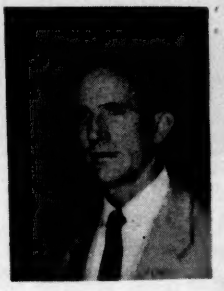
• H. K. Porter Co., Inc., Pittsburgh, Pa., has acquired The Watson-Stillman Co., Roselle, N. J. Operations will continue under the direction of Edwin A. Stillman, president, at the new division.

• L. F. Reimann has been promoted to assistant vice-president of manufacturing at Jackson and Church Co., Saginaw, Michigan. Associated with the firm for 27 years, Mr. Reimann has been superintendent of two plants in the Saginaw area prior to the promotion.

GETTING PERSONAL

George F. Haines, Jr. (co-author, *Industrial Heat Exposures*, page 93) is a chemical engineer at the Industrial Hygiene Foundation, Mellon Institute, Pittsburgh, Pa. From 1943 to 1948 he was with other fellowships at the Institute. He is the author of two previous articles on radiant heat. Mr. Haines is a graduate of Bucknell University and has studied at the University of Pittsburgh.

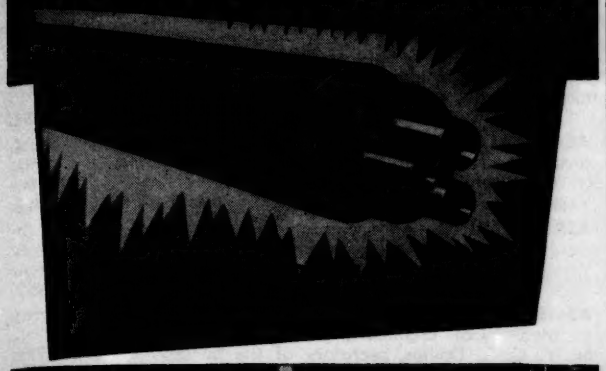
T. F. Hatch



G. F. Haines, Jr.

Theodore F. Hatch (co-author, *Industrial Heat Exposures*, page 93) is research adviser to the Industrial Hygiene Foundation, Mellon Institute, Pittsburgh, and professor of industrial health engineering at the University of Pittsburgh Graduate School of Public Health. Before joining the Foundation in 1945 Mr. Hatch was lt. colonel and executive officer of the Armored Medical Research Laboratory at Fort Knox, Kentucky, and served in the Pacific Theatre where his duties included the ventilation of tanks. Before Army service he was associate professor of industrial hygiene, School of Medicine, University of Pennsylvania. From 1936 to 1940 Mr. Hatch served as dust control engineer for the New York State Department of Labor in charge of the engineering office of the Division of Industrial Hygiene. Earlier he had served as a sanitary engineer for the Tennessee State Department of Health. Graduated from the University of Maine in Civil Engineering, 1924, he took graduate work in sanitary engineering at Harvard University, and served as instructor in industrial hygiene at Harvard from 1926-36. Mr. Hatch is the author of numerous publications on industrial hygiene. He is a co-author with Professor Philip Drinker of Harvard of the book, *Industrial Dust*. Mr. Hatch was selected to present the Cummings Memorial Lecture, sponsored by the American Industrial Hygiene Association in 1951. In 1950 he was appointed official representative of the United States Government to the International Conference of Experts on Pneumoconiosis of the International Labor Organization at Sydney, Australia.

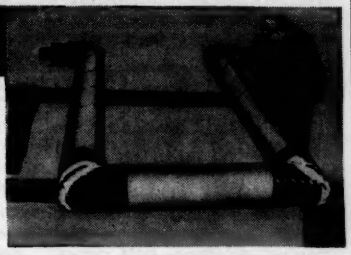
THE BEST ENGINEERING SPECIFICATION FOR INSULATED PIPE LINES



COMPLETE PROTECTION

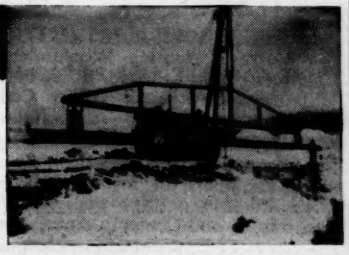
Ric-wiL HEL-COR Units are designed for severe service conditions. The strong, shock-proof housing is 16-gauge Armco ingot iron, spirally-corrugated, hot-dipped galvanized, and rust-proofed "Bonderized." Outside is given a ⅛" thick covering of high-melting point asphalt and asbestos felt, and inside coated with phenolic resin, baked-on — a multiple layer of protection against moisture and corrosion.

CERTIFIED WELDING



Built by skilled craftsmen, all Ric-wiL systems are designed and welded to comply with the requirements of the A. S. M. E. Code for Pressure Piping, and we are authorized to apply the appropriate Code symbols. Piping and conduit are rigidly inspected and tested before leaving our factory — your assurance of trouble-free piping performance.

PREFABRICATED UNITS



All parts and fittings, including complete expansion loops or packless-type joints, are delivered to job site in easily-handled units of sound engineering design — eliminating many installation steps entirely and lowering final costs. These versatile units may be safely installed under city streets, railroad tracks, or suspended overhead.

Ric-wiL Systems range in size from 6" conduits to giant 84" diameter Utilidors designed to carry all utility services. Put Ric-wiL's broad experience to work for you — ask us for latest literature or discuss your next piping project with a Ric-wiL representative.

THE RIC-WIL COMPANY
Mfgrs. Insulated Piping and Conduit Systems
UNION COMMERCE BLDG. • CLEVELAND OHIO

LEADERS IN INSULATED PIPING PROTECTION

TUTTLE & BAILEY Inc.

"the following equipment is recommended for testing AEROFUSE DIFFUSERS... Alnor VELOMETER"

That's the recommendation of Tuttle & Bailey for measuring *actual* air delivery of their diffusers—precisely and quickly in the field.

They know from their own tests—in their own complete laboratory—that a few simple readings with a Velometer equipped with a 2230 jet minimizes the time-consuming job of balancing out a system on installation.

The Velometer is the *only* instantaneous, direct-reading air velocity meter—accurate in all ranges, from high to low—compact, portable, easy to understand and use. Wide assortment of jets and fittings makes this precision instrument ideally suited for all air velocity measurement.

Get an Alnor Velometer for your air measurement needs. You'll save time and money wasted in balancing air distribution on your *next* job. If you'd like a copy of Tuttle & Bailey instructions on balancing Aerofuse Diffusers with the Velometer, just send the coupon below.

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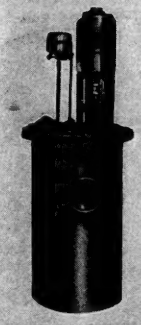
Any engineer will tell you **Skidmore** offers more pump performance

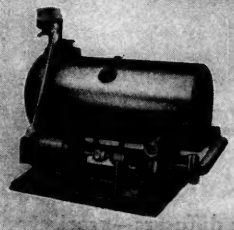


There's a wide range of types and capacities for every heating pump need. Let Skidmore advise you on your next tough job.

TYPE UV

Type UV Condensation Pump is designed for below floor level returns, and is built in single and duplex units.

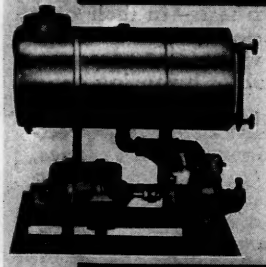
Write for *Bulletin No. 19-A*



TYPE HS

Type HS Pump is recognized for its dependable low operating cost. Capacities range from 1,000 to 65,000 sq. ft. EDR and pressures from 10 to 75 pounds.

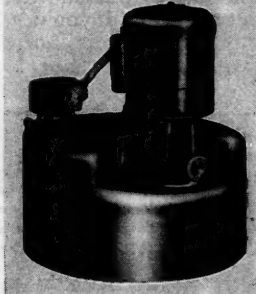
Write for *Bulletin No. 14-A*



TYPE TM

Type TM High Pressure Turbine Pump. Designed for pressures up to 150 pounds and boilers to 250 H.P.

Write for *Bulletin No. 17*



TYPE CV

Type CV Vertical Pump is ideal where space is limited. This model like every Skidmore Pump is built to meet specific requirements. For the correct solution to your own pump problem consult a Skidmore Heating Pump Specialist.

Write for *Bulletin No. 21*

Sales representatives in principal cities
SKIDMORE CORP., ST. JOSEPH, MICHIGAN

SKIDMORE PUMPS

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

SANITARY ENGINEERING MEETING—46th annual meeting of the American Society of Sanitary Engineering, at the McAllister Hotel, Miami, Fla. Herbert Schalber, annual meeting city chairman, 46 N. E. 6th St., Miami, Fla. ..... **NOVEMBER 15-20, 1952.**

ASA MEETING—34th annual meeting of the American Standards Association, at the Waldorf Astoria Hotel, New York, N. Y. Secretary of the Association, 70 East 45th Street, New York. ..... **NOVEMBER 19, 1952.**

ASRE MEETING—48th annual meeting of the American Society of Refrigerating Engineers, at the Hotel Commodore, New York, N. Y. Secretary, M. C. Turpin, 40 W. 40th St., New York 18, N. Y. .....**NOVEMBER 30-DECEMBER 3, 1952.**

ASME MEETING—Annual meeting of the American Society of Mechanical Engineers, at the Hotel Statler, New York, N. Y. C. E. Davies, secretary of the Society, 29 West 39th St., New York, N. Y....**NOVEMBER 30-DECEMBER 5, 1952.**

NATIONAL POWER SHOW—20th National Exposition of Power and Mechanical Engineering, under the auspices of the American Society of Mechanical Engineers, at Grand Central Palace, New York, N. Y. Charles F. Roth, manager of the Exposition, Grand Central Palace, New York 17, N. Y. ..... **DECEMBER 1-6, 1952.**

WARM AIR CONVENTION—39th annual convention of the National Warm Air Heating and Air Conditioning Association, at the Sheraton Gibson Hotel, Cincinnati, Ohio. George Boeddener, 145 Public Square, Cleveland, Ohio .....**DECEMBER 3-4, 1952.**

REMA EDUCATIONAL EXHIBIT—10th Refrigeration and Air Conditioning Educational Exhibit and Conference, sponsored by the Refrigeration Equipment Manufacturers Association, at Municipal Auditorium, Miami, Fla. Annual meetings of the Refrigeration Service Engineers Society and the Refrigeration and Air Conditioning Contractors Association will be held in Miami at that same time. Secretary of REMA, W. Vernon Brumbaugh, 1346 Connecticut Ave., Washington 6. D. C. ..... **DECEMBER 5-7, 1952.**

CHEMICAL ENGINEERS MEETING—Annual meeting of the American Institute of Chemical Engineers, at the Cleveland and Carter Hotels, Cleveland, Ohio. Stephen Tyler, secretary of the Institute, 120 E. 41st Street, New York, N. Y. ..... **DECEMBER 7-10, 1952.**

AUTOMOTIVE ENGINEERS MEETING—Annual meeting and engineering display of the Society of Automotive Engineers, at at the Sheraton-Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 West 39th St., New York, N. Y. .....**JANUARY 12-16 1953.**

PLANT MAINTENANCE SHOW AND CONFERENCE—Plant Maintenance show and conference at the Public Auditorium, Cleveland, Ohio. Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. ..... **JANUARY 19-22, 1953.**

HEATING WHOLESALERS MEETING—The annual meeting of the National Heating Wholesalers Association, Inc., at the Congress Hotel, Chicago, Ill. E. L. Wyman, executive secretary of the Association, 637 Union Commerce Building, Cleveland 14, Ohio. .....**JANUARY 26-28, 1953.**

ASHVE EXPOSITION—The Air Conditioning Exposition, under the auspices of The American Society of Heating and Ventilating Engineers, at the International Amphitheatre, Chicago, Ill. Write to exposition management, International Exposition Co., Inc., Grand Central Palace, New York 17, N. Y. .....**JANUARY 26-30, 1953.**

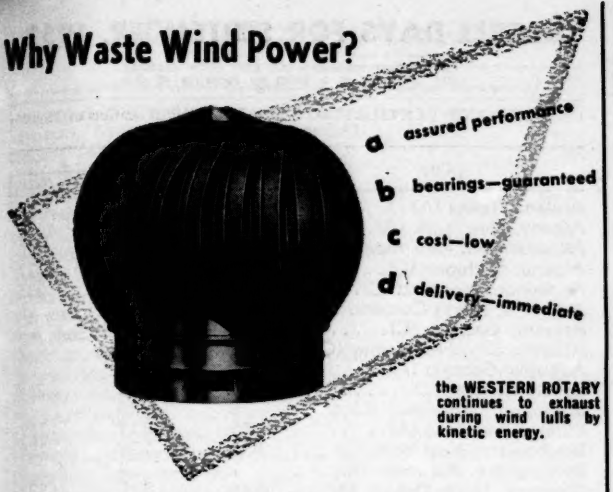
ASHVE MEETING—59th annual meeting of the American Society of Heating and Ventilating Engineers, at the Conrad Hilton Hotel, Chicago, Ill. A. V. Hutchinson, secretary of the Society, 62 Worth St., New York 13, N. Y. ..... **JANUARY 26-30, 1953.**

TESTING MATERIALS MEETING—Spring meeting of the American Society for Testing Materials, at the Hotel Statler, Detroit, Mich. Secretary of the Society, 1916 Race St., Philadelphia 3, Pa. ..... **MARCH 2-6, 1953.**

CORROSION ENGINEERS EXHIBIT—1953 conference and exhibition of the National Association of Corrosion Engineers, at the Hotel Sherman, Chicago, Ill. Executive secretary of the Association, 1061 M & M Bldg., Houston 2, Texas. ..... **MARCH 16-20, 1953.**

NDHA MEETING—44th annual meeting of the National District Heating Association, at Lookout Mountain Hotel, Chattanooga, Tenn. John F. Collins, secretary of the Association, 827 N. Euclid Ave., Pittsburgh 6, Pa. ..... **JUNE 9-12, 1953.**

Why Waste Wind Power?



a assured performance
b bearings—guaranteed
c cost—low
d delivery—immediate

the WESTERN ROTARY continues to exhaust during wind lulls by kinetic energy.

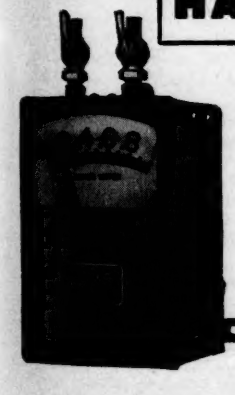
Lifetime guaranteed bearings—bearings that stay in alignment. Both bearings mounted on same axis. Long-lasting metallic-leafing paint finish on durable galvanized steel. Clean, low modern silhouette, completely functional. Throat sizes 6" thru 48" . . . Order today from your wholesaler. Write for prices, specifications, other information. In 1952 Sweet's, A.E.C., Heating, Ventilating & Air Conditioning Guide.

"always on the job—never on the payroll"

WESTERN ENGINEERING & MFG. CO.
4118 OCEAN PARK AVENUE VENICE CALIFORNIA

know the condition of your air filters

HAYS AIR FILTER GAGE



easy to read—large dial, visible at a distance.

easy to check at zero—no oil to evaporate and no leveling is required.

constant accuracy—with Hays "slack diaphragm", measuring unit retains accuracy. Outside zero adjusting screw provided.

send for Bulletin 48-751

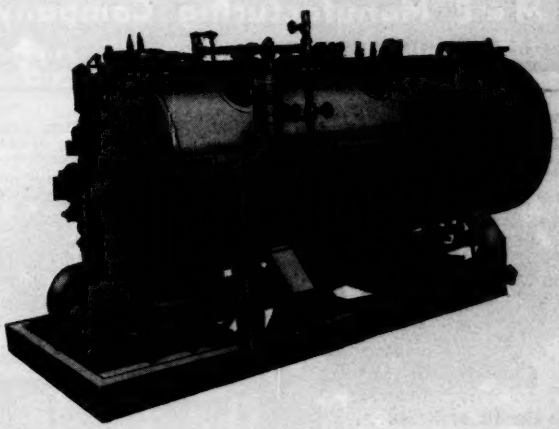
Get complete details on this accurate indicator of filter efficiency. The Hays Air-Filter Gage measures the actual resistance air meets passing through the filter. You KNOW when it's time to replace. Can be furnished with flash or sound alarms or with damper controls.

THE **HAYS** CORPORATION
Michigan City 28, Ind.
combustion and industrial instruments and control

YOU GET REAL SERVICE WITH AMESTEAM GENERATOR

Before Installing . . .
A Complete Manual on "How To Do It"

After Installing . . .
Our LOCAL Service Man Starts Unit and Provides Three Months Free Service



Nineteen Sizes — 10 to 500 h.p.
15# to 200# w.p.
OIL or GAS

WRITE FOR BULLETIN 1050

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BOX H-11 OSWEGO, N. Y.
Builders of Better Boilers Since 1848

M&E HEAVY DUTY EXHAUST UNIT for Hazardous Locations

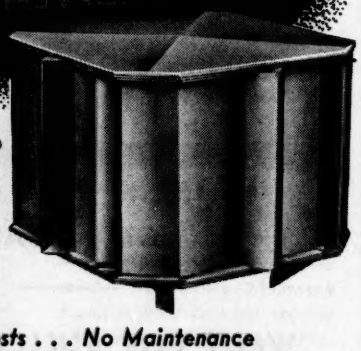
Designed For
- Spray Booths
- Low Temperature Ovens
- Flo Coaters
- Washers
- And other hazardous locations

Engineering Data On Request

- Sealed for life bearings
- Static free operation
- High bearing overload factor
- Built to standard of fire insurance underwriters
- Precision balanced

M & E Manufacturing Company
2575 Winthrop Ave. Indianapolis, Indiana

NOW . . . ADEQUATE LOW COST VENTILATION



AGITAIR® WIND-ACTUATED EXHAUSTERS

No Power Costs . . . No Maintenance
Perform Efficiently Regardless of Wind Direction

Now . . . with Agitair Exhausters, a hole in the roof becomes a complete ventilating system. Yes . . . every gentle breeze can be put to work to provide positive, adequate ventilation. Agitair Wind-Actuated Exhausters draw hot, stale air, steam or odors from the area being ventilated . . . regardless of wind direction or velocity. They prevent back-drafting, and are completely weatherproof under all conditions.

Write for Bulletin EX 103

AIR DEVICES, Inc.
17 East 42nd St. • New York 17, N. Y.
Air Diffusers • Air Filters • Roof Exhausters

DEGREE-DAYS FOR SEPTEMBER, 1952

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 25th Year of Publication of Monthly Degree-Day Data

City	September		
	1952	1951	Normal
Abilene, Texas (A)	4	10	0
Albany, New York (A)	130	172	72
Albuquerque, New Mexico (A)	13	3	0
Alpena, Michigan (C)	183	265	222
Anaconda, Montana (C)	131	376	335
Asheville, North Carolina (C)	38	19	0
Atlanta, Georgia (C)	0	3	0
Atlantic City, New Jersey (C)	12	29	0
Augusta, Georgia (A)	0	0	0
Baker, Oregon (C)	132	181	258
Baltimore, Maryland (C)	8	23	0
Billings, Montana (A)	75	312	189
Binghamton, New York (C)	103	128	108
Birmingham, Alabama (A)	1	2	0
Bismarck, North Dakota (A)	146	310	222
Block Island, Rhode Island (A)	64	53	0
Boise, Idaho (A)	63	88	102
Boston, Massachusetts (A)	62	65	48
Bozeman, Montana (C)	200	379	336
Buffalo, New York (A)	123	158	75
Burlington, Iowa (A)	81	125	(a)
Burlington, Vermont (A)	143	187	144
Butte, Montana (C)	208	441	344
Cairo, Illinois (C)	4	24	0
Charleston, South Carolina (C)	0	0	0
Charlotte, North Carolina (C)	6	9	0
Chattanooga, Tennessee (A)	8	3	0
Cheyenne, Wyoming (A)	150	306	240
Chicago, Illinois (C)	56	91	76
Cincinnati, Ohio (C)	22	33	0
Cleveland, Ohio (A)	79	107	27
Columbia, Missouri (A)	51	80	0
Columbia, South Carolina (C)	0	4	0
Columbus, Ohio (C)	55	62	0
Concord, New Hampshire (A)	151	198	168
Concordia, Kansas (C)	29	113	0
Dallas, Texas (A)	0	0	0
Davenport, Iowa (C)	59	105	0
Dayton, Ohio (A)	69	96	0
Deer Lodge, Montana (C)	287	398	399
Denver, Colorado (C)	68	139	72
Des Moines, Iowa (A)	77	147	0
Detroit, Michigan (A)	95	116	42
Devils Lake, North Dakota (C)	207	371	276
Dodge City, Kansas (A)	25	96	0
Dubuque, Iowa (C)	153	206	36
Duluth, Minnesota (C)	281	400	270
Eastport, Maine (A)	220	200	276
Elkins, West Virginia (A)	158	148	63
El Paso, Texas (A)	0	0	0
Ely, Nevada (A)	176	214	(a)
Erie, Pennsylvania (C)	85	102	36
Escanaba, Michigan (C)	243	284	243
Evansville, Indiana (A)	39	55	0
Fargo, North Dakota	166	302	240
Fort Smith, Arkansas (A)	3	8	0
Fort Wayne, Indiana (A)	109	140	0
Fort Worth, Texas (A)	0	0	0
Fresno, California (A)	16	0	0
Galveston, Texas (C)	0	0	0
Grand Junction, Colorado (A)	14	36	0
Grand Rapids, Michigan (A)	127	188	57
Green Bay, Wisconsin (C)	213	257	132
Greensboro, North Carolina (A)	21	20	0
Greenville, South Carolina (A)	0	3	0
Harrisburg, Pennsylvania (A)	48	55	0
Hartford, Connecticut (A)	73	101	48
Hatteras, North Carolina (C)	0	0	0
Havre, Montana (C)	122	349	270
Helena, Montana (A)	174	388	251
Houston, Texas (C)	0	0	0
Huron, South Dakota (A)	118	260	123
Indianapolis, Indiana (A)	73	112	0
Jackson, Mississippi (A)	0	0	(a)
Kansas City, Missouri (A)	25	68	0
Knoxville, Tennessee (A)	3	9	0
La Crosse, Wisconsin (A)	133	208	96
Lander, Wyoming (A)	95	279	276

(a) Data not available.

City	September		
	1952	1951	Normal
Lansing, Michigan (A)	156	190	114
Lewiston, Maine (O)	151	102	165
Lincoln, Nebraska (C)	41	120	0
Little Rock, Arkansas (A)	2	6	0
Livingston, Montana (C)	123	336	227
Los Angeles, California (C)	0	0	0
Louisville, Kentucky (A)	15	45	0
Lynchburg, Virginia (A)	42	33	0
Macon, Georgia (A)	0	0	0
Madison, Wisconsin (C)	127	201	87
Marquette, Michigan (C)	215	319	225
Memphis, Tennessee (A)	5	10	0
Meridian, Mississippi (A)	0	0	0
Milwaukee, Wisconsin (A)	126	181	84
Minneapolis, Minnesota (A)	143	242	93
Moline, Illinois (A)	97	130	(a)
Montgomery, Alabama (A)	0	0	0
Nantucket, Massachusetts (A)	113	60	63
Nashville, Tennessee (A)	11	17	0
New Haven, Connecticut (A)	68	72	39
New Orleans, Louisiana (C)	0	0	0
New York, New York (C)	13	44	50
Newark, New Jersey (A)	22	48	0
Norfolk, Virginia (C)	0	8	0
North Head, Washington (C)	233	273	255
North Platte, Nebraska (A)	92	198	42
Oakland, California (C)	25	65	90
Oklahoma City, Oklahoma (C)	4	23	0
Omaha, Nebraska (A)	60	128	0
Oswego, New York (C)	110	162	114
Parkersburg, West Virginia (C)	54	68	0
Peoria, Illinois (A)	80	119	3
Philadelphia, Pennsylvania (C)	10	24	36
Phoenix, Arizona (C)	0	0	0
Pittsburgh, Pennsylvania (C)	38	84	0
Pocatello, Idaho (A)	85	147	156
Portland, Maine (A)	185	195	162
Portland, Oregon (C)	49	47	105
Providence, Rhode Island (C)	69	71	63
Pueblo, Colorado (A)	53	115	6
Raleigh, North Carolina (C)	7	9	0
Rapid City, South Dakota (A)	74	274	144
Reading, Pennsylvania (C)	32	50	0
Red Bluff, California (A)	7	2	(a)
Reno, Nevada (A)	107	92	144
Richmond, Virginia (C)	11	17	0
Rochester, New York (A)	109	150	72
Roswell, New Mexico (A)	14	17	0
Sacramento, California (C)	11	3	0
St. Joseph, Missouri (A)	40	94	0
St. Louis, Missouri (C)	10	42	0
Salt Lake City, Utah (A)	36	64	18
San Antonio, Texas (A)	0	0	0
San Diego, California (A)	1	1	0
Sandusky, Ohio (C)	74	89	0
San Francisco, California (C)	128	172	114
Sault Ste. Marie, Michigan (A)	249	363	276
Savannah, Georgia (A)	0	0	0
Scranton, Pennsylvania (C)	94	114	60
Seattle, Washington (C)	88	110	186
Sheridan, Wyoming (A)	111	336	264
Shreveport, Louisiana (A)	0	0	0
Sioux City, Iowa (A)	84	195	33
Spokane, Washington (A)	100	163	192
Springfield, Illinois (C)	32	71	0
Springfield, Missouri (A)	35	69	0
Syracuse, New York (A)	103	145	96
Tacoma, Washington (C)	139	148	207
Terre Haute, Indiana (A)	77	108	0
Toledo, Ohio (A)	94	123	9
Topeka, Kansas (C)	25	84	0
Trenton, New Jersey (C)	29	45	0
Utica, New York (O)	108	181	182
Valentine, Nebraska (C)	101	249	93
Walla Walla, Washington (C)	34	39	30
Washington, D. C. (C)	14	22	0
Wichita, Kansas (A)	15	59	0
Williston, North Dakota (C)	151	351	270
Winnemucca, Nevada (C)	136	131	192
Yakima, Washington (A)	80	125	120

(a) Data not available.

Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

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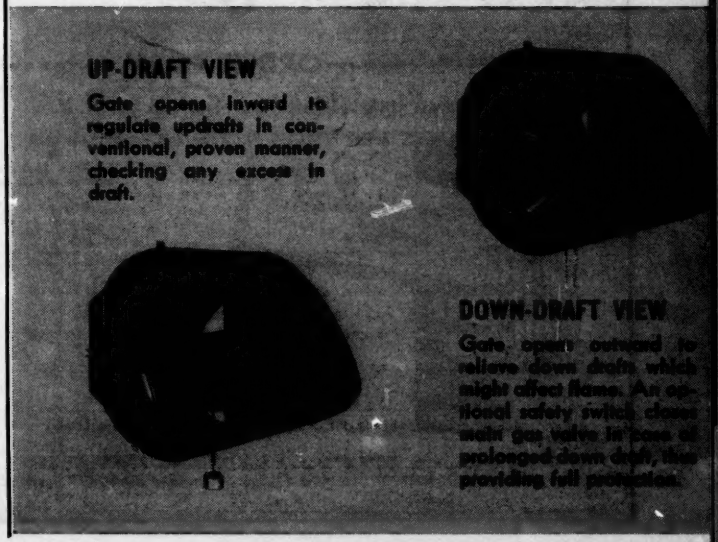
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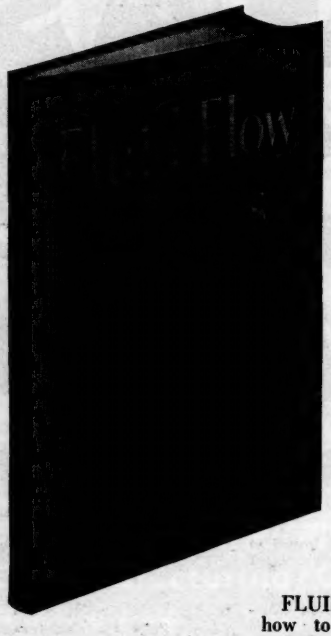

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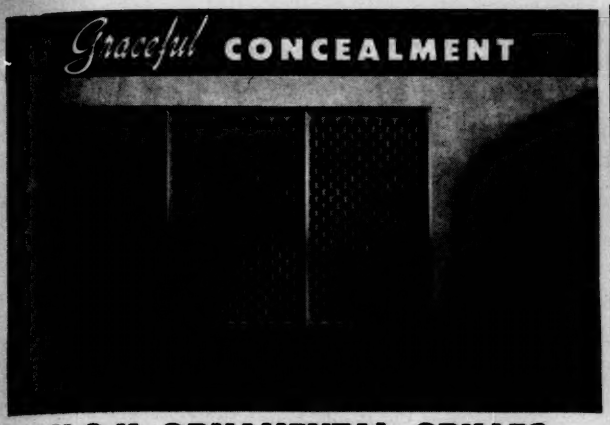

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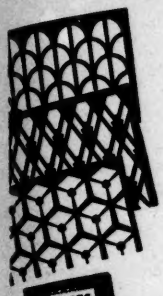

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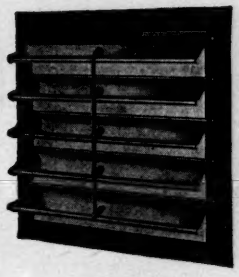

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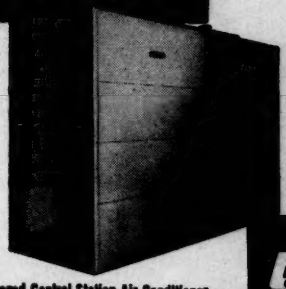

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SPOT HEATING WITH UNIT HEATERS

Spot heating, the heating of a relatively small, unenclosed area or volume within a much larger enclosed or partially enclosed space, is seldom entirely successful. This is undoubtedly true because results are usually unpredictable, and because there is an almost total lack of design data available based on either experience or theory.

Yet the designer cannot ignore the fact that in spite of its shortcomings, spot heating is often necessary. The necessity of supplying heat to the operator of a sawmill; to the operator of a punch press or shear in an unheatable steel warehouse; or to an internal combustion engine intermittently operated in extremely cold weather, are typical examples.

In such cases the use of the light-weight, suspended, propeller-type unit heater is often a good practical answer. This equipment lends itself well to the solution of most spot heating problems at reasonable cost. It is available as a standard product in several styles and many sizes for a wide range of steam pressures. First cost, installation cost, and operating expense are reasonable and it can easily be moved or relocated. Even more important, it is compact and easily controlled.

The following discussion of this important matter has been prepared by H. E. Smith.

Any discussion of this subject must be predicated on two basic rules which will invariably apply to any spot heating job regardless of its individual pecularities.

(1) Extreme caution must be used in making performance predictions. It is folly, for example, to promise or attempt to get a draftless 60 or 70F temperature for an isolated spot in an open building subject to zero weather.

(2) Completely disregard unit heater manufacturers' published data concerning heat-throw and mounting height. Those data are necessarily based on normal complete heating in a reasonably well enclosed structure. They cannot be used to estimate performance in spot heating applications.

Design suggestions supplementary to these two cardinal rules may be given but they must be used conservatively bearing in mind that they are the result of actual observation and trial and error, rather than of prolonged technical observation and testing under laboratory conditions.

Spot heating installations fall broadly into two categories, stationary and portable.

Portable installations may be fairly complex mechanically but they are usually relatively simple to design because they are inherently simple to adjust. For example, spot heating equipment to thaw and dry railway switches or car running gear or to preheat aircraft engines or to temporarily heat box cars during loading may well involve a unit heater mounted on a truck or trailer and supplied with steam through a flexible hose or from a small truck-mounted steam generator. In such systems, the unit heater can usually be placed extremely close to the spot to be heated and the heated air can further be localized by special discharge nozzles or by restraining tarpaulins.

Much more difficult to design and therefore meriting more detailed discussion, is the more commonly encountered stationary spot heating system, usually involving the supplying of heat for the operator of a solitary machine or localized process within a much larger unheated building.

Both vertical and horizontal discharge unit heaters may be used in such applications, the decision being governed by the shape and physical peculiarities of the space to be heated, location of available steam facilities, and the presence of physical obstructions. The presence of a low overhead conveyor system might dictate the use of a vertical delivery unit, but a traveling crane at a considerable height might make a horizontal delivery unit necessary, possibly installed at or near the floor level, since spot heating can seldom be done satisfactorily from an extreme height.

In making this preliminary survey, it is essential to drastically restrict the mounting height of the unit or units. Heat losses, as they are usually considered in a normal heating problem, are meaningless in a spot heating application. The objective is to blanket the prescribed space with a constant stream of warmed air. Obviously, then, the volume of this imaginary three dimensional space to be heated must be restricted as much as possible. Since the height of that space is fully as important as its length and width (or diameter), the unit heater must be kept as low as possible. Even more important, however, is the fact that the warmed air discharged from the unit must penetrate extremely cold air. Because of the great temperature difference between the warm air and cold air and because there are no supplementary heating units in the adjacent unheated spaces to set up helping air currents, the heated air is extremely buoyant. It tends literally to bounce up to the ceiling where it is not wanted.

The length and width, or diameter, of the space to be heated must be determined very closely. Partially confining walls, such as a low partition, even if only two or three feet in height, are extremely helpful since they minimize the tendency of cold drafts to flow along the floor from the unheated section into the space to be heated. Similarly, a ceiling or canopy, partial or complete and as low as possible, is of real value since it restricts the tendency of the heated air to rise rapidly to the unheated ceiling spaces. This, of course, is particularly desirable in high ceilinged rooms. The value of these features is sufficiently great to justify a real effort by the designer to provide them.

Where such retaining walls are provided, the length and width of the space to be spot heated may be considered as being the dimensions of the walled-in space. Where such walls are not possible, these dimensions should be the length (or width) of the space to be heated plus ten feet.

Where a restraining canopy is possible, the height may be taken as the actual height to the canopy. Where

such a ceiling is not practical, the height of heated space should be considered as being heater mounting height plus 50% but plus at least six feet, unless the resulting figure exceeds the actual ceiling height of the building in which case the latter will apply.

Having obtained these three dimensions, the volume should be determined and a unit heater (or heaters) should be selected having desirable final air temperatures and outlet velocity characteristics and which will provide from 15 to 30 air changes per hour by using the formula

$$C = \frac{V \times A}{60}$$

where C is the air delivery capacity of the unit heater in cfm, V is the volume of space to be heated in cubic feet, and A is the number of air changes per hour.

Judgment must be used in estimating the required number of air changes per hour since it is impossible to set up universally applicable formulae. The maximum of 30 air changes should always be used where the large building is so poorly constructed as to be little more than a windbreak; for small areas of less than about 250 sq ft of floor area; for areas near often-opened doors; and for larger areas which are exposed (not adjacent to restraining walls) on all four sides or which are long and narrow or otherwise shaped so as to present a comparatively large perimeter for the escape of the heated air. Conversely, the number of air changes may be safely reduced for larger spaces enclosed on one or two sides by the building walls and for large, compact areas which represent a fairly great percentage of a reasonably tight and well constructed building.

Care must be used to select unit heaters having a good final air temperature under the anticipated operating conditions of steam pressure (or water temperature) and entering air temperature which is assumed to be the lowest probable temperature of the unheated space. These characteristics can usually be obtained from the manufacturer's catalog. The final air temperature under these design conditions should be the entering air temperature plus about 65 degrees but not less than 90 degrees. This requirement may dictate the use of low outlet temperature units, particularly if high pressure steam is used.

The velocity of the air leaving the unit heater is also important though the allowable limits are extremely difficult to define and considerable judgment must be used for each individual installation. Unavoidable errors in judgment may often be minimized or corrected by the use of an adjustable diffuser if the error has been made in selecting a unit with too much velocity. Obviously, little can be done if units having a velocity which is too low are selected. In general, when overhead *horizontal* delivery units are used at limited heights of not more than 7 or 9 ft, outlet velocities should range from 850 or 900 fpm for small units of about 1,300 cfm to 1,200 or 1,400 fpm for larger units of about 4,000 cfm. When vertical delivery units are used, velocities should range from 950 or 1,000 fpm for 1,500 cfm units to around 1,900 fpm for 8,000 cfm units.

The importance of maintaining low mounting heights has already been discussed. Here, again, it is difficult to prescribe definite limits but, in general, horizontal delivery units should never be mounted more than 7 to 9 ft high unless they are very large . . . exceeding 5,500 cfm and 1,700 fpm. Vertical delivery units should be limited to a maximum of 10 ft unless they are very large (exceeding about 6,000 cfm) in which case they may set as high as 20 ft.

These suggestions outline the simplest type of spot heating system but in many cases it is practical to incorporate added refinements which will add greatly to efficiency and performance of the installation.

Recirculating ducts with either horizontal or vertical delivery units to draw the inlet air from the floor area of the heated space should be used wherever they are physically possible. This will permit use of a design entering air temperature at least 20F above the normal room temperature of the surrounding unheated space and it will reduce the design number of air changes per hour by 25%. In such cases the ductwork should be approximately full size of the unit heater inlet with a minimum of bends and other restrictions. Inlet openings instead of grilles should be used in order to minimize the static loss.

Another refinement which is often practical and always efficient is the use of unit heaters discharging horizontally just above the floor into the space to be heated. If this is done, lower outlet velocities are desirable and several small units should be used in preference to one large unit. A similar system, equally good but not always practical because of construction difficulties, involves a unit discharging vertically upward through a grille or grilles in the floor below the operator's feet. This might dictate a horizontal delivery unit taking its inlet air through a duct from the outside of the heated space and discharging upwards in the center of the space. An inverted vertical delivery unit under the floor can be used but it is difficult to prevent dirt and debris from falling into the unit through the floor grille. Here, again, lower velocities and small units should be used and outlet temperatures should be low. In both of these suggested arrangements, particularly if the heated space is fairly large, the units may well be supplemented by overhead verticals to confine the heated air within the prescribed zone.

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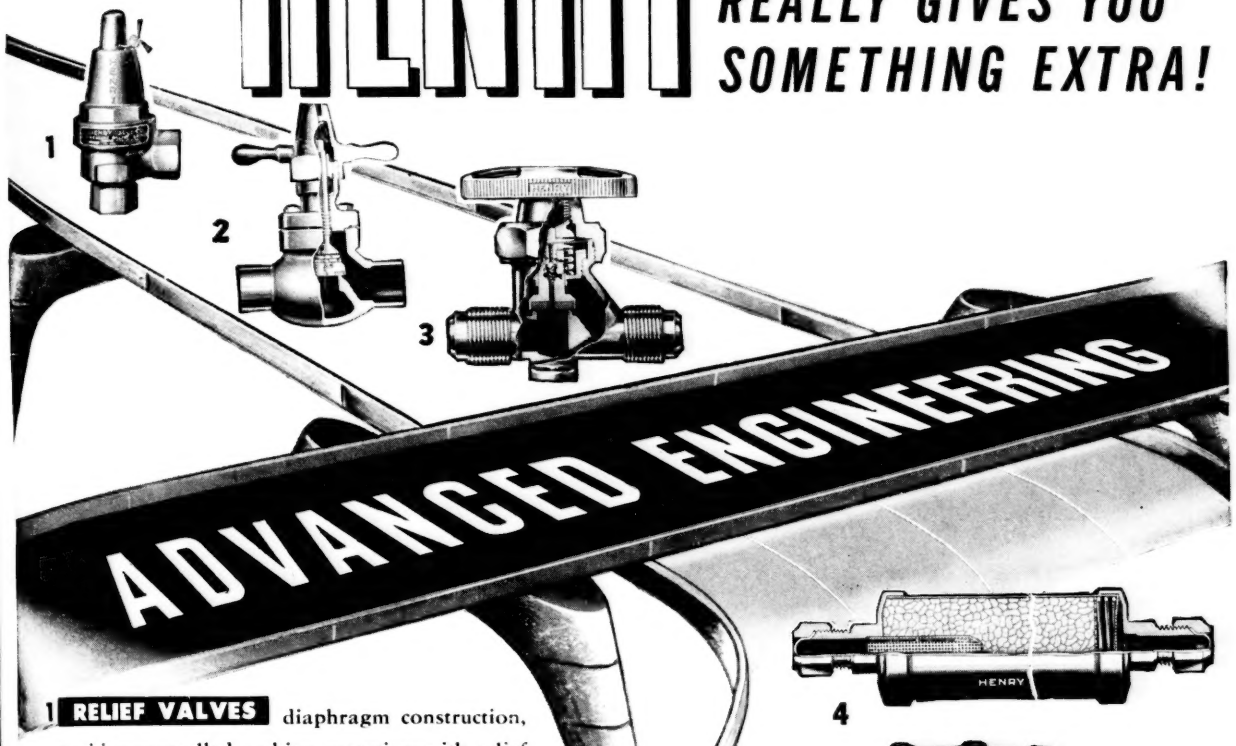

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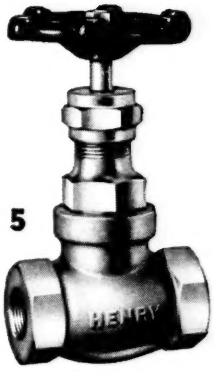

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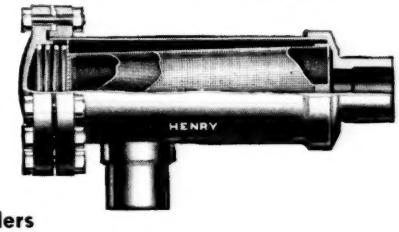

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